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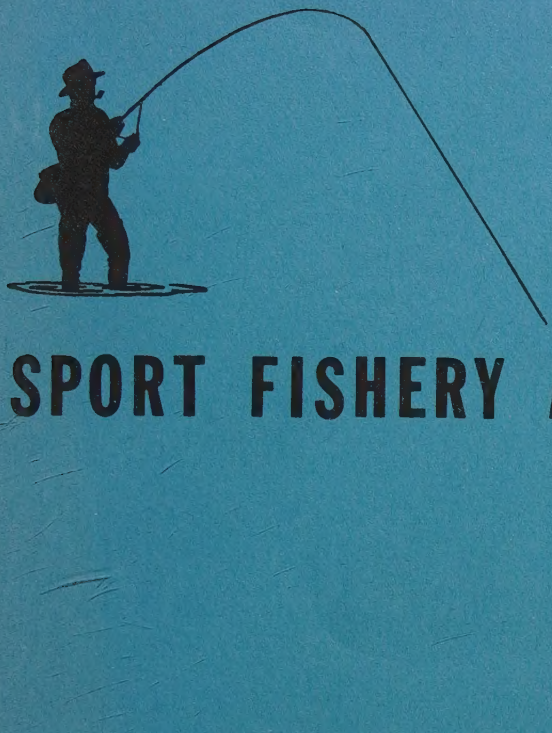

SPORT FISHERY ABSTRACTS

Vol. 11, No. 1, 1966

Abstracts 8301 - 8500

DEPARTMENT OF THE INTERIOR

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

DEPARTMENT OF THE INTERIOR

Stewart L. Udall, Secretary

U. S. FISH AND WILDLIFE SERVICE

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BUREAU OF SPORT FISHERIES AND WILDLIFE

John S. Gottschalk, Director

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SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 11, No. 1 Abstracts 8301-8500 1966

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

One volume consisting of four numbers is issued each year. Each number contains separate Author and Subject indexes. The final number of each volume contains cumulative Author and Subject indexes and a list of publications screened.

Suggestions for improving the usefulness and scope of Sport Fishery Abstracts are solicited.

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8301. Manar, Thomas A. (Bur. of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii). 1966. PROGRESS IN 1964-65 AT THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, HONOLULU. U.S. Fish and Wildlife Service Circular 243. 42 p.

This report deals with research results achieved by the Bureau of Commercial Fisheries Biological Laboratory in Honolulu from January 1, 1964, to June 30, 1965. Described are developments in the following fields: the sensory capacities of tunas; tuna behavior; subpopulations research using genetic techniques; studies of the ecology of the skipjack tuna and the albacore tuna; biological surveys of the Indian Ocean; investigations of the oceanography of the Hawaiian Islands area and of the entire Pacific; and studies devoted to the evaluation of the use of a submarine for research in fisheries and oceanography. Publications issued or in press during the period are listed. (Auth.)

8302. Stevens, E. Don, and Edgar C. Black (Dept. of Physiology, Univ. of British Columbia, Vancouver, B.C.). 1966. THE EFFECT OF INTERMITTENT EXERCISE ON CARBOHYDRATE METABOLISM IN RAINBOW TROUT, Salmo gairdneri. Jour. Fish. Res. Board Canada, 23(4): 471-485.

The effect of intermittent severe exercise of short duration on carbohydrate metabolism was examined using unanesthetized, intact rainbow trout. The levels of muscle glycogen were determined in fish sampled immediately after severe exercise of 3 sec to 5 min, after recovery of 3 min to 60 min, and after re-exercise of 3 sec to 5 min. It appears that rainbow trout are not well adapted to tolerate frequent exercise of short duration. (Authors)

8303. Hergenrader, Gary L., and Arthur D. Hasler (Laboratory of Limnology, Dept. of Zoology, Univ. of Wisconsin, Madison). 1966. DIEL ACTIVITY AND VERTICAL DISTRIBUTION OF YELLOW PERCH (Perca flavescens) UNDER THE ICE. Jour. Fish. Res. Board Canada, 23(4): 499-509.

Use of echo sounders showed that, under the ice in Lake Mendota, yellow perch (Perca flavescens Mitchill) have a bimodal diel pattern of activity. The first peak of activity, during midmorning, was much higher than the second, in mid-afternoon. Schools of fish in mid water made up the bulk of the fish traces per hour although individual fish were also commonly recorded. At night, when activity was much reduced, principally single fish were observed. The fish swam much more slowly at night than during the day. The activity pattern generally agreed with those reported by investigators for other lakes in that the perch were active during the day and relatively inactive at night. No well-defined change in depth distribution was noted. There was a tendency for the fish to move away from the bottom to a limited extent at night but no marked movement was recorded. The majority of fish were most often recorded at a depth of 30-60 feet (9-18 m), the main concentrations being in areas of the lake more than 50 feet (15 m) deep. (Authors)

8304. Deibert, Irv. 1966. HOLY COW. Sports Afield, 155(4): 108.

Six manatees have been introduced into a specially fenced sector of canal near Fort Lauderdale in a study of the effect these large mammals will have on aquatic vegetation. They have proved to be excellent weed eaters and the studies will continue to see how they will breed in their new environment.

8305. Fujino, Kazuo (Bur. of Commercial Fisheries Biological Lab., Honolulu, Hawaii). 1966. INSTRUCTIONS FOR COLLECTING BLOOD AND SERUM SAMPLES FROM TUNA FISHES. Food and Agriculture Organization of the U.N. Fisheries Circular No. 26. 5 p.

8306. Miller, Robert Rush, and Charles H. Lowe. 1964. THE VERTEBRATES OF ARIZONA. PART 2. AN ANNOTATED CHECK LIST OF THE FISHES OF ARIZONA. University of Arizona Press, Tucson. pp. 133-151.

8307. Crossman, E. J. 1966. A TAXONOMIC STUDY OF Esox americanus AND ITS SUBSPECIES IN EASTERN NORTH AMERICA. Copeia, 1966, No. 1. pp. 1-20.

Examination of the range-wide variation in 13 morphological characters, of biology, of color pattern and three anatomical features of the redfin and the grass pickerels showed them to be subspecifically distinct. For each of these subspecies, Esox a. americanus Gmelin and E. a. vermiculatus LeSueur, there are areas within which values for various characters are uniform and these areas delineate their ranges along the Atlantic coast and in the Mississippi River-Great Lakes watersheds. They do, however, intergrade across a broad front in the Gulf of Mexico region from the St. Johns River in Florida, to the Biloxi River, Mississippi. In this region it is impossible to assign individuals to either form. Over the areas of uniformity, the forms can be distinguished on the basis of two snout proportions, two scale characteristics, and, probably, color in young. Values overlap for other characters studied. The synonymy is reviewed and details of distribution are given. (Auth.)

8308. Neil, E. H. (Dept. of Zoology, Univ. of California, Berkeley). 1966. OBSERVATIONS ON THE BEHAVIOR OF Tilapia mossambica (Pisces, Cichlidae) IN HAWAIIAN PONDS. Copeia, 1966, No. 1. pp. 50-56.

Three different Hawaiian habitats were studied in August 1960 to determine whether the behavior and color changes of wild Tilapia mossambica (Peters) were similar to those of aquarium-raised fish. The Hawaiian animals performed all of the activities described for aquarium-raised fish. Color changes were similar, and their occurrence could be predicted from previous correlations between behavior and color changes of laboratory-raised animals. Schools of Hawaiian fish from three to six cm in length and schools of fish of over six cm long remained separate. Individuals were often seen singly for periods of over 10 min whereas aquarium-raised animals usually rush back to the school within one min. Tilapia zilli and Acanthurus sanvicensis, which were somewhat similar in size, shape, and coloration to T. mossambica, were courted and then chased. The other inhabitants of the ponds were ignored or eaten. In the brackish-water pond studies, the water level fluctuated with the tide. When the water level dropped 30 cm below mean sea level, all animals left their territories and schooled. Courtship behavior appears to be cyclic in both wild and aquarium-raised T. mossambica. The social conditions under which courtship activities were performed differed in the aquarium and in the Hawaiian ponds. The lack of interference by other fish in Hawaii may account for the fact that females required 90 min less to spawn in the wild than in the aquaria. (Auth.)

8309. Schoffman, C. S. V. (Griffin High School, Springfield, Illinois). 1965. GROWTH OF WHITE CRAPPIE IN REELFOOT LAKE, TENNESSEE. Journal of the Tennessee Academy of Science, 40(1): 6-8.

The study of age and growth of white crappie in Reelfoot Lake, Tennessee, has extended over a period of twenty-five years. The maximum growth rate was reached in 1948 followed by a slow decrease to the time of the present study. During this period changes in fishing regulations resulted in a decrease in the growth rate and an increase in the population. At the present time Reelfoot Lake is over populated with white crappie. Since the prohibition of commercial fishing, sportsmen have been catching more small white crappie each year. The appearance of age group 2 in 1959 with its increase to 46 percent of the specimens taken in 1964 shows that an overpopulation exists. The restriction of white crappie fishing to sport fishing is of no value unless there is a depletion of fish due to biological causes. Since there is no such depletion, the restriction is unnecessary. In 1950 Schoffman stated that, because of overpopulation, sport fishing would not exist within six years if commercial fishing were stopped. This prediction of 1950 has become a reality in 1964.

8310. Daniels, Stacy L., Lloyd L. Kempe, Thomas J. Billy, and Alfred M. Beeton. 1965. DETECTION AND MEASUREMENT OF ORGANIC LAMPRICIDE RESIDUES. Great Lakes Fishery Comm. Technical Report No. 9, Ann Arbor, Mich. 18 p.

The selective lampricide, 3-trifluoromethyl-4-nitrophenol (TFM), and its synergist, 5,2'-dichloro-4'-nitrosalicylanilide (DCN), are separable from natural waters by anion exchange. The adsorbed compounds can then be recovered from the resin as concentrates by elution with selective solvent mixtures. Measurements of the amounts of lampricides in the final concentrates can be made colorimetrically at 395 mμ for TFM and at 530 mμ for the safranin complex of DCN. TFM has also been separated for quantitative determination from homogenates of whole fish. The fish is first macerated in a blender and then hydrolyzed in hot, 3 N hydrochloric acid. The amount of background color, due to certain components of the fish in the hydrolysate, is reduced by one or a combination of three methods: (1) a series of three extractions with ether, methylene chloride, and benzene; (2) cation exchange followed by methylene chloride extraction; or (3) ether extraction followed by anion exchange and subsequent desorption with amyl acetate-acetic acid. (Authors)

8311. Copeland, B. J. (Inst. of Marine Science, Univ. of Texas, Port Aransas). 1965. FAUNA OF THE ARANSAS PASS INLET, TEXAS. I. EMIGRATION AS SHOWN BY TIDE TRAP COLLECTIONS. Publications of the Institute of Marine Science, Volume 10. pp. 9-21.

A tide trap was used to sample the animals in the Aransas Pass Inlet, Texas. The net was lowered three days per week at maximum flood and ebb tides during the period between April 15, 1963 and April 15, 1964. About 24 species of invertebrates and 55 species of fishes were collected with the tide trap during the study. Total catch of all organisms was greatest in May-June and in October. These large peaks were concomitant with the change in water level of the bays and changes in temperatures. Most organisms were caught on ebb tide, indicating a mass emigration of animals from the shallow productive nursery areas. Only Anchoa spp. were consistently caught during flood tides. Six species of invertebrates and 11 species of fishes were considered to be common emigrants and were caught in the tide trap in large numbers. All of these organisms demonstrated definite patterns in their emigration habits. Computations showed that the net productivity of the bays as shown by tide trap collections was 233 kg/acre per year. About 3.9×10^6 kg/year of late juvenile peaneid shrimp emigrated through the Aransas Pass Inlet. (Auth.)

8312. Jones, Robert S., B. J. Copeland, and H. D. Hoese (Inst. of Marine Science, Univ. of Texas, Port Aransas). 1965. A STUDY OF THE HYDROGRAPHY OF INSHORE WATERS IN THE WESTERN GULF OF MEXICO OFF PORT ARANSAS, TEXAS. Publications of the Institute of Marine Science, Volume 10. pp. 22-32.

A one-year study of the hydrography was conducted during 1962 and 1963 on a 25 nautical-mile transect running 112° from Port Aransas, Texas. Thermal stratification was found to exist approximately 50% of the time at most stations with turnover in October and March. Light penetration was an effective method of distinguishing water masses. Optical density profiles increased in slope near the bottom during summer, indicating more opaque water on the bottom. Gulf and coastal water masses were distinguished by the degree of inclination of optical density plots. An intermediate water mass, which may be a part of Gulf water, was detected within the range of the transect during both winter and summer. However, northers drove the line of demarcation more offshore on several occasions during winter. Offshore species of larval fishes were found inshore only when offshore water masses moved inshore. (Authors)

8313. Miller, John M. (Inst. of Marine Science, Univ. of Texas, Port Aransas). 1965. A TRAWL SURVEY OF THE SHALLOW GULF FISHES NEAR PORT ARANSAS, TEXAS. Publications of the Institute of Marine Science, Volume 10. pp. 80-107.

Between February and July, 1964, bi-monthly hauls were made in the 3-15 fathom zone of the Gulf off Port Aransas, Texas. Data presented for each of the 68 species captured include numbers, date and depth of capture, water temperature

and size range taken. Also noted are size groups and ripe individuals. Where sufficient numbers of juveniles of a species were caught, its spawning season was estimated, based on growth data from other studies. For several species a migratory pattern was indicated. The data are compared with those of other studies of both surrounding habitats and other Gulf areas, and in most cases indicated the same migratory pattern and spawning season. Finally, the species for which no migratory pattern was indicated are grouped according to depth preference. (Auth.)

8314. Parker, Jack C. (Bur. of Commercial Fisheries Biological Laboratory, Galveston, Texas). 1965. AN ANNOTATED CHECKLIST OF THE FISHES OF THE GALVESTON BAY SYSTEM, TEXAS. Publications of the Institute of Marine Science, Volume 10. pp. 201-220.

This checklist includes fishes collected from Galveston Bay, Texas, in the course of regularly scheduled sampling operations by the Bureau of Commercial Fisheries during the years 1961-64. All other species known to occur in this bay system are also listed. The annotations, although incomplete in many instances, indicate the relative abundance of each species, as well as its distribution with respect to area, season, and salinity. Such information is based on observations by the author and those recorded in the literature. In all, 162 species represented by 122 genera and 66 families are listed. (Auth.)

8315. Armstrong, Robert H. 1965. ANNOTATED BIBLIOGRAPHY ON THE DOLLY VARDEN CHAR. Alaska Dept. of Fish and Game, Juneau, Research Report No. 4. 26 p.

This bibliography brings together 130 references from Canada, Japan, Russia, and the United States on the distribution, classification, life history and general biology of the Dolly Varden. (Auth.)

8316. Armstrong, Robert H. 1965. SOME MIGRATORY HABITS OF THE ANADROMOUS DOLLY VARDEN Salvelinus malma (Walbaum) IN SOUTHEASTERN ALASKA. Alaska Dept. of Fish and Game, Juneau, Research Rept. No. 3. 36 p.

The migratory habits of the Dolly Varden char were investigated at Eva Creek, a typical lake-stream system on Baranof Island, Southeastern Alaska, from May 1 to November 12, 1962, and from March 16, 1963 to March 15, 1964. A weir was built across Eva Creek, and all Dolly Varden migrating to sea from Eva Lake were enumerated and marked by fin clipping and/or tagging. After leaving Eva Creek, the Dolly Varden migrated in all possible directions. Marked fish were recovered in 25 stream systems, some as far as 72 miles from Eva Creek. After an average of 116 days, 40 to 44 percent of the marked fish returned to Eva Lake for the winter. In addition, large numbers of Dolly Varden which had not spent the winter in the lake entered it the following fall. A weir was built across Saook Creek, a nonlake system, located 10 miles west of Eva Creek on Baranof Island. Thirty-seven percent of the fish entering this system were marked fish from Eva Creek. By November all Dolly Varden of migratory size had left Saook Creek, and 68 percent of these fish had entered Eva Lake for the winter. Major differences in the migratory habits of Dolly Varden entering the nonlake and lake-stream systems were found. It was believed that the lake-stream systems were being used as wintering areas by Dolly Varden originating in the many nonlake streams throughout this area. (Auth.)

8317. Phillips, Arthur M. Jr., Donald L. Livingston, and Hugh A. Poston (Bur. Sport Fisheries and Wildlife, Cortland, New York). 1966. USE OF CALORIE SOURCES BY BROOK TROUT. Progressive Fish-Culturist, 28(2): 67-72.

A reduction in the calorie and protein content of trout diets reduced growth rate. Increasing the calorie content of these diets with corn oil to levels isocaloric with control diets restored their growth potential. A protein-sparing action by fat was shown by increased deposition of body protein in trout receiving the oil-supplemented diets. Relatively high levels of body fat in the oil-fed trout indicated a surplus of energy in these diets. No evidence was found for a sparing

action of white dextrin on the food protein, although white dextrin in the diet did result in increased fat deposition. (Authors)

8318. Dumas, Richard F. (New York State Conservation Dept., Cortland). 1966. OBSERVATIONS ON YOLK SAC CONSTRICTION IN LANDLOCKED ATLANTIC SALMON FRY. Progressive Fish-Culturist, 28(2): 73-75.

Yolk sac constriction in landlocked Atlantic salmon (Salmo salar) fry has often been noted in New York State fish hatcheries. This study attempts to correlate its appearance with water temperature during incubation and sac life. Apparently a steady temperature or a warm temperature triggers this phenomenon. (Auth.)

8319. Armbruster, Daniel (Ohio Division of Wildlife, Columbus). 1966. HYBRIDIZATION OF THE CHAIN PICKEREL AND NORTHERN PIKE. Progressive Fish-Culturist, 28(2): 76-78.

An estimated 25,000 eggs obtained by stripping a 14-inch chain pickerel (Esox niger) and fertilized with sperm from two male northern pike (E. lucius) produced a 65.5% hatch. Casual observations were made on the hybrids for approximately 11 months after hatching. The hybrids showed a negligible mortality at water temperatures exceeding 70° F. as compared to the large losses of muskellunge (E. masquinongy) and chain pickerel held in adjacent rearing troughs. Growth of the hybrids was intermediate to that of the parent species. Partial squamation was noted in 35.7% of the fingerlings examined, and the opercules were fully scaled in the others. The color pattern more nearly paralleled that of the northern pike than the chain pickerel. (Auth.)

8320. Kramer, Robert H., and Lloyd L. Smith, Jr. (Univ. of Minnesota, St. Paul). 1966. SURVIVAL OF WALLEYE EGGS IN SUSPENDED WOOD FIBERS. Progressive Fish-Culturist, 28(2): 79-82.

Walleye eggs (Stizostedion vitreum vitreum) were incubated under controlled laboratory conditions at 12° C. in suspensions of wood fibers from paper-making operations. Concentrations of 0, 100, and 250 ppm (dry weight) aspen groundwood, conifer groundwood, conifer sulfite, and conifer kraft pulps were tested in recirculating-flow vessels and were found to have no effect on egg-hatching success. Conifer groundwood, tested in a continuous-flow apparatus at 0, 60, 125, and 250 ppm at 3.6 and 10.8 ppm dissolved oxygen, also had no effect on survival of walleye eggs through hatching. (Authors)

8321. Putz, R. E., and G. L. Hoffman (Bur. Sport Fisheries and Wildlife, Kearneysville, W. Va.). 1966. EARLIEST SUSCEPTIBLE AGE OF RAINBOW TROUT TO WHIRLING DISEASE. Progressive Fish-Culturist, 28(2): 82.

At the conclusion of a 3-month experiment initiated with 5,000 eyed rainbow trout eggs, none of the fish that had been exposed to Myxosoma cerebralis only as eggs became infected with whirling disease, but those that had been exposed as sac fry for as little as 3 days showed the gross symptoms and spores.

8322. Post, George, and Milton M. Beck (Bur. Sport Fisheries and Wildlife, Ft. Collins, Colorado). 1966. TOXICITY, TISSUE RESIDUE, AND EFFICACY OF ENHEPTIN GIVEN ORALLY TO RAINBOW TROUT FOR HEXAMITIASIS. Progressive Fish-Culturist, 28(2): 83-88.

Toxicity of Enheptin to rainbow trout (Salmo gairdneri) was of a low order showing an LD_{50} of 390 mg of Enheptin per kilogram of fish per day when given for 6 days. Enheptin residues up to 48 ppm were found in muscle tissue of fish given levels of 425 mg of the drug per kilogram of fish per day for 5 days. A dry trout diet containing 0.4% Enheptin produced drug residues of 5 ppm in the muscle tissue after feeding for 6 days; no residue of Enheptin was found 4 days after withdrawal of the drug. Addition of as much as 0.4% Enheptin to dry trout diets was palatable to the fish. Excellent elimination of Hexamita salmonis was affected at levels of 70 and 90 mg of Enheptin per kilogram of fish per day when given on a free-choice basis for 3 days. (Authors)

8323. Bennett, George W., and William F. Childers (Illinois Natural History Survey, Urbana). 1966. THE LAKE CHUBSUCKER AS A FORAGE SPECIES. Progressive Fish-Culturist, 28(2): 89-92.

Through an accidental introduction and its ability to multiply and survive in habitat already inhabited by warm-water fishes, the lake chubsucker (Erimyzon sucetta) became established in a large water-filled stone quarry in central Illinois inhabited by largemouth bass, smallmouth bass, crappies, bluegills, redear sunfish, green sunfish, grass pickerel, and bullheads. The lake chubsucker produced schools of fry in the shallows at a time when bass fry were schooling in the same areas. Experimental stocking of the lake chubsucker with largemouth bass, with smallmouth bass, and with largemouth bass and several kinds of hybrid sunfish, has indicated its usefulness. This species is desirable because it produces large numbers of young at an optimum time and location, it usually does not grow too large to fall prey to the larger bass, it does not increase the turbidity of the water even when relatively abundant, and it does not build up excessively large populations. (Authors)

8324. Cumming, Kenneth B. (Bur. of Commercial Fisheries Biological Lab., Woods Hole, Massachusetts). 1966. DISPOSABLE AQUARIA. Progressive Fish-Culturist, 28(2): 92.

Fish boxes lined with plastic bags, stacked on plywood bases on cement-block pedestals in tiers, make inexpensive aquaria in which to hold the fish necessary for the multiple treatments, replicates, and controls required by modern experimental design.

8325. Mason, James E. (Bur. Commercial Fisheries Biological Lab., Seattle, Wash.). 1966. THE MIGRANT DIPPER: A TRAP FOR DOWNSTREAM-MIGRATING FISH. Progressive Fish-Culturist, 28(2): 96-102.

A new type of fish trap, automatic and substantially self-cleaning, is described. It is adaptable for fishing under a variety of conditions. In one form it is better suited for low velocities or small amounts of debris; in a second form, for higher velocities and greater amounts of debris. Field tests indicate that the migrant dipper may produce fewer injuries and deaths, operate over a greater range of water velocities, and be less selective as to size of fish caught than traps now in use. Aside from being more effective as a sampling device, this trap may supplant certain other types of fish-catching devices for both biological and engineering advantages. (Auth.)

8326. Reimers, Norman (Bur. Sport Fisheries and Wildlife, Sierra Nevada Aquatic Research Lab., Bishop, Calif.). 1966. A LOW-MAINTENANCE FISH BARRIER WITH FREE-FLOW CHARACTERISTICS. Progressive Fish-Culturist, 28(2): 103-107.

A metal barrier consisting of horizontally stacked, suitably spaced tubing (electrical conduit) is described as to mode of operation, construction, and use in an experimental stream facility. Maintenance advantages resulting from hydraulic passage of debris, low clogging rate, and separability of tubes in cleaning are discussed. (Auth.)

8327. Novotny, Anthony J., and Diptiman Chakravarti (Bur. Commercial Fisheries, Fish-Passage Research Program, Seattle, Wash.). 1966. A VERSATILE FORCE-FEEDING SYSTEM FOR EXPERIMENTAL USE WITH SMALL FISH. Progressive Fish-Culturist, 28(2): 108-112.

An economical pellet-forming machine and a force-feeding tool has been developed for experimental studies of materials ingested by small fish. Experimental substances such as pesticides, chemical compounds, and radioisotopes can be added to the diet mixture before formation of pellets, and can be force-fed to small fish (80 to 100 millimeters) without difficulty. Information is given on preparation of pellet ingredients, commercial bullet reloading press, methods of producing pellets, control of pellet quality and uniformity, and force-feeding equipment and techniques. (Authors).

8328. Tait, Howard D. (Bur. Sport Fisheries and Wildlife, Division of Federal Aid, Washington, D. C.). 1966. THE SCIENCE INFORMATION EXCHANGE: A SHARP TOOL FOR FISHERY RESEARCH. Progressive Fish-Culturist, 28(2): 117-119.

The organization, operation, and services available from the Science Information Exchange are described. Basically, the Exchange is a modern, computerized system for the storage, retrieval, and dissemination of information on current research. Its services are free to all organized research groups and should be of substantial benefit to both individual researchers and administrators planning research programs. Participation by research groups is not complete, and individuals are urged to register their research with the Exchange and use the services available. (Auth.)

8329. Gebhardt, Gary A., Raymond E. Millemann, Stuart E. Knapp, and Peter A. Nyberg (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis). 1966. "SALMON POISONING" DISEASE. II. SECOND INTERMEDIATE HOST SUSCEPTIBILITY STUDIES. Journal of Parasitology, 52(1): 54-59.

The fishes Cottus perplexus, Lampetra richardsoni, L. tridentata, and Richardsonius balteatus and the Pacific giant salmander, Dicamptodon ensatus, all from western Oregon streams, were found naturally infected with metacercariae of Nanophyetus salmincola, the "salmon poisoning" fluke. This is the first report of natural infections in an animal other than a fish and in nonsalmonid fishes. Fourteen species of fishes were experimentally infected: Salmo gairdneri, S. salar, S. trutta, Salvelinus fontinalis, S. namaycush, Lampetra richardsoni, Cottus perplexus, Carassius auratus, Richardsonius balteatus, Catostomus macrocheilus, Lepomis macrochirus, Gasterosteus a. aculeatus, G. a. microcephalus, and Gambusia affinis. This extends the number of salmonid and nonsalmonid fishes susceptible to experimental infection. Cysts from all five of the naturally infected animals and from 12 of the 14 experimentally infected fishes were given to hamsters by stomach tube. In all instances except one (probably because of low dosage), the identification of the parasites as N. salmincola was confirmed by recovery of adult flukes from the hamsters. The possibility that N. schikhobalowi from Far Eastern Siberian humans, dogs, cats, and foxes, Vulpes vulpes, and N. salmincola are synonymous is discussed. (Authors)

8330. Hurley, Donal A., and Kenneth C. Fisher (Dept. of Zoology, Univ. of Toronto, Toronto, Ontario, Canada). 1966. THE STRUCTURE AND DEVELOPMENT OF THE EXTERNAL MEMBRANE IN YOUNG EGGS OF THE BROOK TROUT, Salvelinus fontinalis (Mitchill). Canadian Jour. of Zoology, 44(2): 173-190.

A study of the external membranes of the developing oocyte of the brook trout, Salvelinus fontinalis, was made by means of electron microscopy. The membrane, zona radiata, which becomes "hardened" in mature eggs after they are shed into water, was observed to begin development at the bases of microvilli which project from the surface of the oocyte. This membrane grows until in the mature egg it is about 50 μ thick. The zona radiata is completely permeated by numerous pore canals. In immature oocytes, the pore canals contain microvilli which arise from the surface of the oocyte. The microvilli make contact with the follicular cells surrounding the developing oocyte. Morphological changes which occur in the zona radiata and the other layers of developing oocytes are described at several stages of development. The relationship between morphological changes in the membranes and the transport of nutrients to the developing oocyte is discussed. The nomenclature of the membranes of the mature trout egg is discussed in relation to the findings of the present study. It is concluded that primary membranes and perhaps secondary membranes are present in the mature trout egg. (Authors)

8331. Putz, Robert E., Glenn L. Hoffman, and Clarence E. Dunbar (Bur. Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, W. Va.). 1965. TWO NEW SPECIES OF Plistophora (Microsporidea) FROM NORTH AMERICAN FISH WITH A SYNOPSIS OF MICROSPORIDEA OF FRESHWATER AND EURYHALINE FISHES. Jour. of Protozoology, 12(2): 228-236.

Two new species of Microsporidea, Plistophora salmonae from steelhead and rainbow trout (Salmo gairdneri) and Plistophora cepedianae from gizzard shad (Dorosoma cepedianum) are described. Schizonts to spores of P. cepedianae were found at one time within the same cyst, while only sporonts and spores of P. salmonae were found within the cyst. An illustrated synopsis of the known Microsporidea of freshwater and euryhaline fishes is given. (Authors)

8332. Hourston, A. S., E. H. Vernon, and G. A. Holland (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. THE MIGRATION, COMPOSITION, EXPLOITATION AND ABUNDANCE OF ODD-YEAR PINK SALMON RUNS IN AND ADJACENT TO THE FRASER RIVER CONVENTION AREA. International Pacific Salmon Fisheries Comm. Bulletin 17, New Westminster, B. C., Canada. 151 p.

The abundance of Canada Non-Fraser fish on both the Northern and Southern Approach was the lowest on record. In some earlier and later years these stocks were at least twice as abundant as in 1959. The abundance of Fraser fish was higher on both approaches than in the two subsequent cycle years but less than in almost all of the earlier years, when some runs appear to have been at least twice as abundant. The lowest level of abundance of Fraser fish occurred in 1961 when they were about one-third as abundant as in 1959. The abundance of United States stocks in 1959 was the lowest on record. United States pinks were most abundant in 1963 when they were eight times as abundant as in 1959. In all but three or four of the 14 cycle years since 1937, United States fish appear to have been more than twice as abundant as in 1959. The Northern Approach run in 1959 was larger than in the two subsequent years but was probably smaller than in any year prior to 1959. Some earlier runs appear to have been at least three times as abundant as that in 1959. The Southern Approach run in 1959 was almost twice as abundant as that in 1961 (the lowest record) and about half as abundant as that in 1963 (one of the highest on record). In almost all of the other years, the Southern Approach run would appear to have been larger than in 1959.

8333. Topp, Robert W. (Coop. Fishery Unit, Univ. of Massachusetts, Amherst). 1965. AN ANNOTATED BIBLIOGRAPHY OF THE WINTER FLOUNDER, Pseudopleuronectes americanus (Walbaum). Contribution No. 14. Massachusetts Division of Marine Fisheries, Dept. of Natural Resources, Boston. 30 p.

This annotated, indexed bibliography of the winter flounder contains 347 entries, including references on the life history, systematics, distribution, abundance, physiology, commercial and sport fisheries, and related fields. The entire geographical and temporal range is considered, current through early 1965. (Auth.)

8334. Swedberg, Donald V. (Bur. Sport Fisheries and Wildlife, North Central Reservoir Investigations, Yankton, S. D.). 1965. AGE AND RATE OF GROWTH OF FRESHWATER DRUM, LEWIS AND CLARK LAKE, MISSOURI RIVER. Proc. South Dakota Acad. Sci. 44. pp. 160-168.

Age and rate of growth of freshwater drum in Lewis and Clark Lake was determined from a collection of 9,495 fish captured in 1962, 1963, and 1964. Age determination and growth histories were calculated from a sample of 1,806 fish using the scale method. The body-scale relation was expressed by the linear regression, $L = 30 + 1.367 R$. Percent deviation in mean annual growth indicated best growth occurred from 1954 through 1956. Growth was slow from 1957 through 1961, and improved in 1962 and 1963. Growth of Lewis and Clark drum was slower than that reported from most other areas of the United States. Time of annulus formation ranged from May 10 to June 30. Annulus formation for mature drum was delayed until completion of spawning. Determination of age at maturity revealed 23 percent of age-group III males and 27 percent of age-group IV females were mature. All male drum were mature at age-group VII and females at age-group VIII. Length-weight relation was expressed by the formula, $\text{Log } W = -5.37937 + 3.17685 \text{ Log } L$. (Auth.)

8335. Nichols, Paul R. (Bur. Commercial Fisheries Biological Laboratory, Beaufort, N. C.). 1966. COMPARATIVE STUDY OF JUVENILE AMERICAN SHAD POPULATIONS BY FIN RAY AND SCUTE COUNTS. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 525. 10 p.

Forty-five juvenile American shad, Alosa sapidissima (Wilson), collections, from 10 major shad producing rivers along the Atlantic coast of North America, were examined to see if differences in meristic counts suggested evidence of discrete river populations. Four meristic characters--pectoral, dorsal, and anal fin rays and scutes--were used. The difference in the counts between locations and between years within rivers was small compared to that between rivers. The differences in counts between rivers indicated that discrete populations of juvenile shad occurred in rivers. (Auth.)

8336. Anderson, William W., and Jack W. Gehringer (Bur. Commercial Fisheries Biological Lab., Brunswick, Ga.). 1965. BIOLOGICAL-STATISTICAL CENSUS OF THE SPECIES ENTERING FISHERIES IN THE CAPE CANAVERAL AREA. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 514. 79 p.

For its size, the Cape Canaveral Area is one of the most productive of any along the south Atlantic coast of the United States. A great deal of this productivity relates to the unique river-lagoon complex. Material is presented under six sections: The commercial fisheries, recreational fishery, fish taken incidental to shrimp trawling, fish and general invertebrate groups taken during exploratory fishing, zooplankton organisms, dip net and trolling collections. The commercial fisheries produced an average of over 6 million pounds, valued at about $1 million over the 4-year period 1959-62. Eight species (shrimp, black mullet, spotted sea trout, red snapper, blue crab, spot, pompano, and king whiting) contributed 91 percent of the weight and 94 percent of the value--shrimp, the most valuable fishery, was 23 percent of the weight and 54 percent of the value. We estimate that the annual sport fishery catch is about 3 million fish weighing a total of about 3.2 million pounds. Nine species (in decreasing order of importance), spotted sea trout, pinfish, puffers, sea trout (other), catfish, king whiting, sheepshead, bluefish, and croaker, account for 76 percent of the total numbers of fish taken and 73 percent of the pounds. Spotted sea trout, the most important sport fish, represented 20 percent of the total numbers of fish and 33 percent of the weight. Estimates of annual total effort of sports fishermen are about 754,000 fishermen fishing about 2,749,000 hours. Fishing effort during spring, summer, and fall is about equal, but is reduced in winter to about half the value for other seasons. Total catch is highest during winter and spring, and lowest in summer. Summaries of life histories are given for several of the more important species. (Authors).

8337. Livingstone, Robert, Jr. (Bur. Commercial Fisheries Biological Lab., Woods Hole, Mass.). 1965. A PRELIMINARY BIBLIOGRAPHY WITH KWIC INDEX ON THE ECOLOGY OF ESTUARIES AND COASTAL AREAS OF THE EASTERN UNITED STATES. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 507. 352 p.

This bibliography, which contains more than 5,470 references, is an initial effort to bring together references on the ecology of estuaries and coastal waters of the eastern United States, and stresses the period 1900-60. It is the starting point for the compilation of a more comprehensive list in the future. The bibliography is in two parts: (1) the complete entries listed alphabetically by authors and (2) a KWIC Index (keyword-in-context) to significant words relevant to title and context. (Auth.)

8338. Rosier, Carl, Norm Johnston, and Russell F. Orrell (Alaska Dept. of Fish and Game, Juneau). 1965. STREAM CATALOG OF SOUTHEASTERN ALASKA REGULATORY DISTRICTS NOS. 5, 6, 7, and 8. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 523. 443 p.

Information about part of Southeastern Alaska salmon streams is cataloged from the voluminous records of the Alaska Department of Fish and Game; the Alaska Salmon Industry; the Fisheries Research Institute of the University of

Washington; the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries; and other agencies. Stream descriptions, maps, and historical records of salmon escapement data are compiled for 130 salmon streams in Southeastern Alaska Regulatory Districts Nos. 5, 6, 7, and 8. Each stream is located geographically by latitude and longitude and by orientation to prominent landmasses. A standard numbering system, number designations formerly in use, and common names of each stream are listed. Physical descriptions are presented for the intertidal zone and the upstream area of each stream. Available records of weather, water temperatures, and information useful to ground and aerial stream surveyors are presented in brief form. The species of salmon utilizing the spawning grounds and estimates of the escapements each year for many years are given. (Authors)

8339. FAO Fisheries Division, Biology Branch (Rome, Italy). 1964. PROCEEDINGS OF THE WORLD SCIENTIFIC MEETING ON THE BIOLOGY OF TUNAS AND RELATED SPECIES. Food and Agriculture Organization of the UN. FAO Fisheries Report No. 6, Vol. 4. pp. 1853-2272.

This bibliography constitutes Volume 4 of FAO Fisheries Report No. 6, Proceedings of the World Scientific Meeting on the Biology of Tunas and Related Species. Volume 1 was the general report of the meeting held at La Jolla, California, U.S.A., from 2 to 14 July 1962, Volume 2 contained synopses of biological information on tuna species, and Volume 3 the methodological and experience papers contributed to the meeting. Volume 4 contains subject, taxonomic and geographic indexes.

8340. Howells, W. Roscoe (Dept. of Zoology, Univ. College of Wales, Aberystwyth). 1964. THE MACROFAUNA OF THE INTERTIDAL SOILS OF THE TOWY ESTUARY, CARMARTHENSHIRE. The Annals & Magazine of Natural History, London England, Vol. 7, No. 82. pp. 37-607.

A quantitative investigation has been made of the intertidal sand and mud of the Towy and Burry estuaries, and Pembrey Sands, Carmarthenshire. A series of traverses was established at successive intervals up the Towy estuary, while one traverse was established at the south of the Burry estuary, and one on the Pembrey Sands. The tidal level of each station was ascertained, and related to Ordnance Datum. At certain stations, samples of the soil were taken, in addition to the faunal samples. A limited amount of information relating to the quality of water in the estuary has been obtained. The species have been listed, and notes have been made on the population densities and distribution of certain of the more characteristic and commonly occurring animals. The horizontal and vertical distributions of the species have been discussed in detail. The species can be divided into groups according to their degree of penetration of the Towy estuary, and it was seen that certain of the species in the Towy show a decreased penetration as compared with the Tamar (Spooner and Moore 1940). While it was seen that certain species occupied definite intertidal zones, little agreement exists among various workers as to the intertidal distribution of other species. The grade size of the soil has been considered and appears to be related to the distribution of the fauna within essentially broad limits. (From auth. summ.)

8341. Moe, Martin A. Jr., and George T. Martin (Florida Board of Conservation Marine Lab., St. Petersburg, Fla.). 1965. FISHES TAKEN IN MONTHLY TRAWL SAMPLES OFFSHORE OF PINELLAS COUNTY, FLORIDA, WITH NEW ADDITIONS TO THE FISH FAUNA OF THE TAMPA BAY AREA. Tulane Studies in Zoology, Tulane Univ., New Orleans, La., 12(4): 129-151.

Monthly collections of fishes were made at nine stations offshore of Pinellas County, Florida, from November 1962 to June 1963. Data on 2,317 fishes, representing 72 species, are reported. Occurrence of various species, relative abundance at certain depths and environmental descriptions are presented. Growth and other biological data are given for the 12 species most numerous in the catch. Salinity differences were not considered significant since the observed range between highest and lowest values was only 6 o/oo. Complete temperature data with a generalized analysis are also presented. Distinctive differences in the

fish fauna at depth ranges of 15 to 18 ft, 25 to 45 ft, and 75 to 105 ft are demonstrated. Fifteen of the species collected are new to the ichthyofauna of the Tampa Bay area. Another 27 species new to the area are included, although they were not taken during the study. The number of fish species reported from the Tampa Bay area is extended to 312. (Authors)

8342. Hopkins, C. L. (Fisheries Lab., Marine Dept., Wellington, New Zealand). 1965. FEEDING RELATIONSHIPS IN A MIXED POPULATION OF FRESHWATER FISH. New Zealand Journal of Science, 8(2): 149-157.

The feeding of Philypnodon breviceps, Salmo trutta fry, Anguilla australis, and A. diffenbachii, is discussed with special reference to the degree and nature of their predation on a common food stock. It was found that mayfly larvae of the family Leptophlebiidae were the commonest items of food, but that bullies, trout fry, and eels each exploited a different size group. (Auth.)

8343. Bass, George A., and Mark Rascovich (The American Museum of Natural History, New York, N.Y.). 1965. A DEVICE FOR THE SONIC TRACKING OF LARGE FISHES. Zoologica, New York Zoological Society, 50(2): 75-82.

A system for tracking large (over 250 lbs.) fishes by sonar is described; it consists of a transmitter attached to the fish, a boat-borne receiver and a sensitive special sensor for use near the instruments' range limit. The transmitter is supplied with 12 watts for about 150 hours from self-contained batteries which provide sonar pulses of 50 to 100 milliseconds every two seconds at 38 KC. The receiver has two hydrophones mounted rigidly underwater and so placed and angled that the signal from them makes it possible to head the boat toward the transmitter-carrying fish, by means of the vessel's steering system. A zero-centered meter and stereo earphones deliver the output from the receiver, which make tracking possible for distances of 1.5 to 2 miles, depending on the speed of the boat and the state of the sea. Tests with sharks and tuna proved that it was fully practicable to follow such a transmitting fish by means of this system. (Authors summ.)

8344. Nigrelli, Ross F., and George D. Ruggieri, (New York Aquarium). 1965. STUDIES ON VIRUS DISEASES OF FISHES. SPONTANEOUS AND EXPERIMENTALLY INDUCED CELLULAR HYPERTROPHY (LYMPHOCYSTIS DISEASE) IN FISHES OF THE NEW YORK AQUARIUM, WITH A REPORT OF NEW CASES AND AN ANNOTATED BIBLIOGRAPHY (1874-1965). Zoologica, New York Zoological Society, 50(2): 83-96.

Forty-nine species of fishes, 20 families from 5 orders, with spontaneous lymphocystis disease (viral induced cellular hypertrophy or cellular gigantism) are reported. Twenty-six of these diseased species, in 11 families and 2 orders, were found in the New York Aquarium's collection. New host records are: Morone americana (white perch) from Tom's River, New Jersey, Lepomis pallidus from Connecticut, Angelichthys ciliaris (queen angelfish) from Florida, Forcipiger longirostris (forceps fish) from Hawaii, Aequidens pulcher (blue acara) from Trinidad and Scatophagus argus (scat) from the Indo-Pacific. A second case in Symphysodon discus (discus or pompador fish) from the Amazon Basin is also reported. Experimental transmission of the disease is recorded for the following cichlids in which the disease has not been previously reported: Hemichromis bimaculatus (fire-mouth), Tilapia macrocephala (black-chinned mouth-breeder), Tilapia ovale (oval Tilapia), and Tilapia sparmanii (Sparman's Tilapia). Lymphocystis disease is briefly described and an annotated bibliography (1874-1965) is included. (Authors summ.)

8345. Pate, D. A., H. H. Funderburk, Jr., J. M. Lawrence, and D. E. Davis. 1965. THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED. Weeds, 13(3):208-210.

Effective chemical control of alligatorweed (Alternanthera philoxeroides Mart., Griseb.) has been prevented by rapid regeneration of plants from inactive axillary buds following treatment with herbicides. Destruction of phloem,

cambium, and associated parenchyma occurred above and within the nodes of plants treated with 2 lb/A dichlobenil (2,6-dichlorobenzonitrile) or dicamba (2-methoxy-3,6-dichlorobenzoic acid). Application of dichlobenil and dicamba in combination increased the extent of tissue destruction. Herbicidal activity was noted within the axillary buds only when vascular strands between bud and stem were well differentiated. (Authors)

8346. Blackburn, R. D., and L. W. Weldon. 1965. THE SENSITIVITY OF DUCKWEEDS (LEMNACEAE) AND AZOLLA TO DIQUAT AND PARAQUAT. Weeds, 13(2): 147-149.

The sensitivity of giant duckweed (Spirodela polyrhyza (L.) Schleid), common duckweed (Lemna minor L.), Wolffiella floridana (Smith) Thomp., azolla (Azolla caroliniana Willd.), and watermeal (Wolffia columbiana Karst.) to diquat (6,7-dihydrodipyrido [1,2-a:2', 1'-c] pyrazidiinium salt) and paraquat (1,1'-dimethyl-4,4'-bipyridinium salt) was in that order (most to least sensitive). The rapidity of chlorosis in giant duckweed was directly related to the light intensity. The light quality having the most effect on the activity of diquat and paraquat on duckweed was red (600+millimicrons), and green (510-560 millimicrons) had the least effect. (Authors)

8347. Conference of Biological Editors, Committee on Form and Style. 1964. STYLE MANUAL FOR BIOLOGICAL JOURNALS. Second Edition. American Institute of Biological Sciences, Washington, D. C. 117 p.

This is the second edition of the Manual published originally in 1960. The Conference of Biological Editors is an organization of editors of biological periodicals, and the Manual was prepared and published in an attempt to avoid the large number of variations in matters of style, which were nothing more than that, in biological journals.

8348. McGilvrey, Frank B., and John H. Steenis (Bur. of Sport Fisheries and Wildlife, Patuxent Wildlife Research Center, Laurel, Md.). 1965. CONTROL OF ALLIGATOR WEED IN SOUTH CAROLINA WITH GRANULAR SILVEX. Weeds, 13(1): 66-67.

Silvex, [2-(2,4,5-trichlorophenoxy)propionic acid], impregnated (20% ae) on clay granules, applied at a rate as low as 20 lb/A ae gave excellent control of well-rooted alligatorweed (Alternanthera philoxeroides, Mart., Grieb) growing in less than 18 inches of water. The 2-ethylhexyl ester of silvex was more effective than the potassium salt. Silvex was not effective on floating-mat alligatorweed or in water over 18 inches deep. (Authors)

8349. Hiltibran, Robert C. (Aquatic Biology Section, Illinois Natural History Survey, Urbana). 1965. THE EFFECT OF DIQUAT ON AQUATIC PLANTS IN CENTRAL ILLINOIS. Weeds, 13(1): 71-72.

Diquat (6,7-dihydropyrido[1,2-a:2', 1'-c] pyrazidiinium salt) was applied to several emergent, submersed, floating-leaved, and free-floating aquatic plants common in Central Illinois ponds. At relatively low rates, it was effective in controlling several submersed aquatic plants but not American pondweed, Potamogeton nodosus, and cabomba, Cabomba caroliniana. This herbicide also was effective on several common emergent species. (Auth.)

8350. Grimås, Ulf (Entomological Dept. Zoological Inst., Uppsala, Sweden). 1965. THE SHORT-TERM EFFECT OF ARTIFICIAL WATER-LEVEL FLUCTUATIONS UPON THE LITTORAL FAUNA OF LAKE KULTSJÖN, NORTHERN SWEDEN. Institute of Freshwater Research, Drottningholm, Sweden, Report No. 46. pp. 5-21.

The short-term effect of impoundment upon the littoral fauna has been studied in the subarctic, oligotrophic Lake Kultsjön, northern Sweden. The composition of the bottom fauna immediately after the impoundment differs from that of older, regulated lakes both quantitatively and qualitatively. No depth zones with divergent and higher abundance of animals are found within the littoral, owing to a heavy

reduction of bottom animals which even extends to littoral areas not directly influenced by draining and freezing. There is an altered balance of species conditioned by the impoundment. Above all there is a negative effect upon the "fish food" organisms and most insect larvae. Thereby the littoral fauna, which originally could be characterized as a chironomid fauna, has changed into an oligochaet fauna. Among the factors discussed, structural changes in the bottom surface are considered to be of great importance within the short-term effect. (Auth. summ.)

8351. Grimås, Ulf (Inst. of Zoology, Entomological Dept., Uppsala, Sweden). 1965. INLET IMPOUNDMENTS. AN ATTEMPT TO PRESERVE LITTORAL ANIMALS IN REGULATED SUBARCTIC LAKES. Institute of Freshwater Research, Drottningholm, Sweden, Report No. 46, pp. 22-30.

The inlet impoundments, with their stable water level throughout the year, complement the fauna of the regulated lake with a community of animals that is normally destroyed by the interference. Their special features as distinguished to the natural littoral are connected with their character as shallow bodies of water. Species that can be assumed to depend upon the possibility of migrating towards greater depths during the winter, e.g. Gammarus lacustris, seem to be hampered in their development. Through the low temperatures in winter and the fast rise of temperature in spring, the course of the temperature seems on the other hand to stimulate the development of benthic cladoceres. The greatest importance of the inlet impoundments lies, however, in the fact that they preserve to the fish available areas with littoral vegetation, and organogenic bottoms and, thereby, areas with a high density of bottom organisms and a balance of species within the fauna which in its main features agrees with that of the original littoral. As an example may be mentioned the dominance of the insects, many of them being important fish-food organisms. (Auth. summ.)

8352. Nils-Arvid Nilsson. 1965. FOOD SEGREGATION BETWEEN SALMONOID SPECIES IN NORTH SWEDEN. Institute of Freshwater Research, Drottningholm, Sweden, Report No. 46, pp. 58-78.

The general experience of the introduction of char into trout-lakes, speaks in favour of the idea that the species combination, as far as arctic-boreal lakes are concerned, is unfavourable as growth rate is depressed by food competition. On the other hand, however, they at the same time share the resources in a way that relatively more organic production could be transformed into fish flesh. "Standing crop per acre increases as the number of species increases or as the niches are filled" (Carlander 1955). It should also be stressed in this connection that the general view arrived at by studying the interrelationships in the high mountain lakes treated here cannot without further notice be applied to other types of lakes. For instance the south Swedish lakes have very different trophic standards, temperature conditions, and general faunistic compositions. The effects of impoundments are in the long run adverse to the fish (S. Runnström 1964). Especially in the case of whitefish the resulting slow-growing and smallsized fish are of little value for the fishermen. The idea has consequently arisen that a predator that better than trout could endure the changed conditions should be introduced in the ecosystem (Svardson 1956, VII). Studies of the food and growth of lake trout (Salvelinus namaycush Walbaum) has indicated that this species might be suitable, although Canadian experiences (Cuerrier 1954) show that it is not always the case.

8353. Fürst, Magnus. 1965. EXPERIMENTS ON THE TRANSPLANTATION OF Mysis relicta Lovén INTO SWEDISH LAKES. Institute of Freshwater Research, Drottningholm, Sweden, Report No. 46. pp. 79-89.

The species Mysis relicta Lovén is euryhaline but the different populations in Swedish lakes seem to be stenohaline. This circumstance complicates transplantation of Mysis relicta between lakes with different electrolyte contents. A method was worked out making it possible to carry out transplantations of Mysis relicta, Pallasea quadrispinosa Sars and Gammaracanthus lacustris Sars in a simple way.

It comprises test cages, a light beam trawl and a chest for storing the animals. (The chest is easily filled and emptied.) Transport can be effected at a great density with the use of oxygen supply. A transplantation to Lake Blåsjön in 1964 of about 1.65 million Mysis relicta and 50 — 100,000 Pallasea quadrispinosa, using this method, is described. All transplantations of fish-food organisms in Sweden made by the Institute of Freshwater Research before 1965 are tabulated. (Auth. summ.)

8354. Halsband, E., and I. Halsband. 1965. INVESTIGATION ON THE ELECTRIC CONDUCTIVITY OF FISH. Archiv fur Fischereiwissenschaft, 16. Jahrgang 1965, Heft 1. pp. 21-32.

Measurements of the resistance of fish were made on various kinds of fish. A new method of measuring fish made it possible to obtain a correct measurement of the specific resistance by Ohm• cm. This method had its foundation on the principle of the decreasing voltage, which occurs between two electrodes in surroundings of different resistance (water and body of the fish). Measurements of the resistance made on whole fish show an average value of 818 Ohm• cm for trout, and 981 • cm for perch. The carp has a specific resistance of 1228 Ohm•cm, the roach 1149 Ohm • cm. An isolated muscle of trout without skin shows a resistance of 283 Ohm • cm, whereas with skin it shows a resistance of 1057 Ohm•cm. The specific resistance of skin can be calculated by the balance of these figures. The resistance of the body of the fish depends greatly on the consistence of its interior and on the nature of its surface. Measurements of the density of current in the body of the fish were made in fresh water of normal and of high conductivity. At the measurements made in fresh water (conductivity of the body of fish = greater than the conductivity of water) the biggest quantity of potential lines flow through the fish (226%). In salty waters (conductivity of water = greater than the conductivity of the body of fish) the current density in the fish reaches only 8.6%, providing the value of the current density of the water = 100%. The results of experiments are also of importance to the practical electrical fishery. (Authors summ.)

8355. Kinney, Edward C. (Bur. Sport Fisheries and Wildlife, Div. Fishery Management Services, Washington, D. C.). 1965. FISHERY MANAGEMENT SERVICES ANNUAL REPORT FOR 1964. Resource Status Report 2. U.S. Fish and Wildlife Service, Washington, D. C. 47 p.

In calendar year 1964 the Division provided technical assistance on 531,781 acres of lakes and ponds and 8,193 miles of streams on Federal areas and Indian reservations. Approximately 2,440 acres of new waters were developed during the year. These Federal and Indian areas provided a total of 4,331,000 man-days of sport fishing.

8356. Klement, Alfred W. Jr., and Vincent Schultz (Div. of Biology and Medicine, AEC, Washington, D. C.). 1965. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A SELECTED BIBLIOGRAPHY — SUPPLEMENT 3. Atomic Energy Comm., Div. of Biology and Medicine, TID-3910, Wash., D. C. 115 p.

The third supplement to the bibliography issued in March 1962. Since there has been increasing interest in the field of radioecology, including the biological aspects of radioactive fallout and waste disposal, it was felt that a rather comprehensive list of publications in the fields of terrestrial and freshwater radioecology would be of interest to many investigators. The lists of unclassified references are believed to include most of the major publications in this field, especially those in the United States.

8357. Tanner, Howard A. 1965. GREAT LAKES SPORT FISHING FRONTIER. Michigan Conservation, 34(6): 2-9.

General account of recent history of the fishery resources, their current status, and the effect of the alewife on the restoration of other fishes. The alewife may prove more detrimental to the sport and commercial fish resources of the upper Great Lakes than was the sea lamprey. Consideration is being given to the feasibility of introducing coho salmon and striped bass which would spawn

in streams where alewife are not found but upon returning to the lakes would use the alewife as food.

8358. Crowe, Walter R. 1965. THE LAKE TROUT ARE BACK. Michigan Conservation, 34(4): 2-7.

The lamprey hasn't given up and probably never will, but it has been reduced to such a point that fishermen are now taking striking numbers of adult lake trout, sure sign lamprey control is working.

8359. Manges, Daniel E. (Tennessee Game and Fish Comm., Nashville, Tenn.). 1965. OOSTANAULA CREEK. A STUDY OF THE ABATEMENT OF STREAM POLLUTION, MCMINN COUNTY, TENNESSEE. Jour. Tennessee Acad. of Science, 40(4): 113-117.

A study of the fishery resources of a stream before and after renovation of the sewage system of a city of 10,000. The ultimate effects are not known, but after only a year and a half the stream environment was considerably improved.

8360. Partin, Luther. 1965. STRIPED BASS. Wildlife in North Carolina, 29(10): 4-7.

Adult fish were taken by shocking and those not having spawned were held in aquaria, stripped of eggs and sperm at the proper time, and returned unharmed to the waters from which they were taken. It was learned that fertilized eggs can be transported successfully in plastic bags fortified with oxygen.

8361. Maher, F. P. (South Bay Fisheries Research Station, Manitoulin Island, Ontario, Canada). 1965. KOKANEE SALMON FOR THE GREAT LAKES. Ontario Fish and Wildlife Review, 4(2): 2-5.

West coast salmon were introduced into the Great Lakes at least as early as 1873. Ontario has started the planting of kokanee salmon in Lake Ontario and Lake Huron. It is hoped that the kokanee will occupy portions of the Great Lakes not frequented by desirable species now present and that it can compete successfully with alewives and smelt.

8362. Martin, N. V. 1965. WENDIGO — THE NOT-SO-EVIL SPIRIT. Ontario Fish and Wildlife Review, 4(3): 12-18.

An account of the splake in Canada. What is now known of the life history, characteristics and possible uses of this hybrid.

8363. Carlson, Frank T. 1965. SUSQUEHANNA RIVER SHAD STUDY. Pennsylvania Angler, 34(10): 1-7.

Adult studies demonstrated that shad given an opportunity to reorient in a current prior to release will, initially, move upstream. Extent of subsequent movements will be known after sonic tracking tapes have been interpreted. Successful spawning will be indicated by presence of juveniles in the river this autumn. A catch of only 46 shad in the trap in Conowingo tailrace suggests a need for refinements in design. Hatching studies were confined to laboratory experiments due to a scarcity of fertilized eggs. Water quality determinations in the 1965 field study area will be compared with results of bio-assay to evaluate its suitability for hatching shad eggs. Scale analyses indicate that some young-of-the-year shad wintered over in the river, principally within the impoundments. (From Auth. summ.)

8364. Piggins, D. J. 1965. SALMON AND SEA TROUT HYBRIDS. Atlantic Salmon Journal, Fall 1965. pp. 3-5.

Hybrids of brown trout (male) and Atlantic salmon (female) have proved to show hybrid vigor for their first two years. The 5-year old fish average 3 pounds and 17-1/2 inches. They have been stripped successfully three times and about 70 percent of the 185,000 fertilized eggs have survived. Back-crosses of both sexes to both species have been successful.

8365. Anonymous. 1965. THE SURVIVAL OF PACIFIC SALMON IN THE ATLANTIC. Atlantic Salmon Journal, Fall 1965. pp. 12-13.

Millions of eggs and fry of Pacific salmon have been placed east of the Continental Divide. Some pink salmon have been taken by commercial fishermen off the coast of Newfoundland and there is evidence of successful spawning in North Harbour River. Some 2,500,000 pink salmon eggs from British Columbia were planted in North Harbour River in 1962.

8366. Saunders, R. L., C. J. Kerswill, and P. F. Elson (Fisheries Research Board of Canada Biological Station, St. Andrews, N.B.). 1965. CANADIAN ATLANTIC SALMON RECAPTURED NEAR GREENLAND. Atlantic Salmon Journal, Fall 1965. pp. 24-26.

Recent records of Atlantic salmon tagged in New Brunswick, Nova Scotia, and Newfoundland being taken near west Greenland.

8367. McCoy, Edward G., and Kenneth H. Johnston (North Carolina Wildlife Resources Comm., Raleigh). THE EFFECTS OF WIND AND SALINITY UPON THE SEDIMENTATION RATES OF SOILS FROM DREDGING SITES IN ALBEMARLE SOUND, NORTH CAROLINA. Division of Inland Fisheries, North Carolina Wildlife Resources Commission, Raleigh. 9 p.

Clay, loam, silt, and sand soil samples collected from dredging sites in Albemarle Sound were suspended in solutions of sea water varying from 0 to 25 percent sea strength. Sedimentation rates were obtained by measuring the amount of light transmission through each solution as described by Coggin, 1960. Test suspensions were placed in a wind tunnel to determine the effect of wind action on sedimentation rates. Except for sand, no appreciable sedimentation of the suspended soils occurred in the zero concentrations of sea water during the entire test period. Rapid sedimentation of the other soil types tested occurred during the first 8 hours in all tests of all sea-water concentrations and no appreciable difference was noted between the various percentages of sea water. A simulated wind velocity of 7 miles per hour had no appreciable effect on the sedimentation rates in 10 percent sea water. A wind velocity of 14 miles per hour precluded any appreciable sedimentation of soils in the sea-water concentrations tested. The agitational effects of wind action on the material suspended in the solutions was greater than the accelerated rate of sedimentation provided by the sea-water concentrations tested. (Authors)

8368. Bayless, Jack, and William B. Smith (North Carolina Wildlife Resources Comm., Raleigh). THE EFFECTS OF CHANNELIZATION UPON THE FISH POPULATIONS OF LOTIC WATERS IN EASTERN NORTH CAROLINA. Division of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh. 14 p.

This paper concerns an evaluation of the effects of habitat alteration associated with stream channelization in eastern North Carolina. The evaluation was based upon a comparison of fish populations found in 23 channeled streams, and 36 proximate natural streams within the Chowan, Neuse, Northeast Cape Fear, Pamlico, Perquimans, and Tar River Watersheds. These comparisons indicated that reductions in the magnitude of 90 percent occurred both in weight of game fish per acre, and in number of game fish exceeding six inches total length per acre, following channelization. The data further revealed that no significant return towards the natural stream populations occurred with a 40-year period following channelization. (Authors)

8369. Tharratt, Robert C. (Calif. Dept. Fish and Game, Sacramento). 1966. THE AGE AND GROWTH OF CENTRARCHID FISHES IN FOLSOM LAKE, CALIFORNIA. Calif. Fish and Game, 52(1): 4-16.

The ages and growth of largemouth bass, Micropterus salmoides, smallmouth bass, M. dolomieui, bluegill, Lepomis macrochirus, and red-ear sunfish, L. microlophus, in Folsom Lake, California, were calculated from scales collected during the first 7 years after impoundment (1955-1961). All year-classes of largemouth bass grew slightly faster than smallmouth bass in the first year of

life, but smallmouth bass grew faster in subsequent years. Red-ear sunfish grew faster than bluegill throughout their life. Largemouth bass growth rates increased during the first 2 years after impoundment and declined subsequently. Smallmouth bass year-classes showed only minor differences in their growth rates. Bluegill growth rates declined markedly throughout the 7 years after impoundment. Red-ear sunfish showed a stable growth pattern for the four year-classes studied. (Auth.)

8370. Turner, Charles H., Earl E. Ebert, and Robert R. Given (Calif. Dept. Fish and Game, Terminal Island). 1966. THE MARINE ENVIRONMENT IN THE VICINITY OF THE ORANGE COUNTY SANITATION DISTRICT'S OCEAN OUTFALL. Calif. Fish and Game, 52(1): 28-48.

During January and February 1965, California Department of Fish and Game biologist-divers made an ecological investigation of the ocean floor in the vicinity of the Orange County ocean outfall. This study, conducted for the State Water Quality Control Board, describes: (i) the animal assemblages present; (ii) the substrate characteristics and (iii) the physical conditions (temperature and clarity) of the water. The 10 stations occupied on the ocean floor included 7 "sampling stations" used by the County in their continuous monitoring program, the outfall terminus, a mid-point on the outfall pipe, and a nearby artificial fishing reef. The faunistic assemblages observed at each station appeared typical for these depths and substrates with two exceptions: (i) a reduced number of species was encrusting the last 100 feet of the outfall pipe compared to the central section, and (ii) considerably fewer kinds and numbers of organisms were observed on the artificial reef than we have seen on artificial reefs which had been submerged in other areas for similar periods at similar depths. We recommend additional diving surveys, conducted at least semi-annually, to define the full effects of this outfall's effluent on the environment. (Authors)

8371. St. Amant, James A. (Calif. Dept. Fish and Game, Chino Fisheries Base, Chino). 1966. ADDITION OF Tilapia mossambica Peters TO THE CALIFORNIA FAUNA. Calif. Fish and Game, 52(1): 54-55.

An established population of tilapia in Imperial County, California, was noted in 1964. A tropical fish farm may have been the source of this population. We attempted to eliminate the fish to prevent their spread into the Salton Sea, but the diverse nature of the water precluded successful eradication. A breeding population is now established in a tributary of the Salton Sea. (Auth.)

8372. Wales, J. H., and R. O. Sinnhuber (Dept. of Food Science and Technology, Oregon State Univ., Corvallis). 1966. AN EARLY HEPATOMA EPIZOOTIC IN RAINBOW TROUT, Salmo gairdnerii. Calif. Fish and Game, 52(2): 85-91.

Two epizootics of rainbow trout hepatoma have occurred in California State trout hatcheries in the past 30 years. The first occurred during the period 1936-42 and the second during 1950-60. Both appear to have been closely associated with the introduction of certain dry plant and animal meals into the diet. Analysis of records for the 1936-42 epizootic plus more recent findings indicate that fish meal or cottonseed meal contained the carcinogen. Chlorinated pesticides and fungicides and solvent residues could not be implicated in the 1936-42 epizootic. Other environmental factors were considered, but these appear to be of negative or indirect importance. (Authors)

8373. Kisaburo, Taguchi. 1965. RETURNING EFFECT AND ITS LIMIT RESULTING FROM THE ARTIFICIAL PROPAGATION FOR CHUM SALMON IN HOKKAIDO. Bull. Japanese Society of Scientific Fisheries, 31(5): 323-326.

In 70 percent of Hokkaido's main rivers all chum salmon entering the rivers are caught and used for artificial propagation. It is estimated that 90 percent of chum salmon runs are brought about by artificial propagation. For the above reason, the effect of artificial propagation can be estimated by studying the relation between the number of parent fish caught in the rivers and the number of total catches both in the rivers and the coast of Hokkaido in the returning year. In this

paper, the above relation is studied by using Ricker's formula ($R = aEe^{-bE}$), and the estimates are given as follow: (1) In Hokkaido, the effect of artificial propagation for chum salmon shows two times the recruitment as compared to that of natural spawning. (2) In the present environment, the most effective number of fry released from hatcheries are about 360 millions. In this case seven returning fish are expected per parent fish. (Auth.)

8374. Aggus, Larry R., and L. O. Warren (Auburn Univ., Auburn, Alabama). 1965. BOTTOM ORGANISMS OF THE BEAVER RESERVOIR BASIN: A PRE-IMPOUNDMENT STUDY. Jour. Kansas Entomological Society, Vol. 38, pp. 163-178.

The bottom fauna of 10 streams in the Beaver Reservoir Basin, Northwest Arkansas, was studied previous to impoundment. The streams were grouped according to size and seasonal pattern of flow. Small spring-fed streams produced the most bottom organisms per unit area, large tributaries produced less, and small streams subject to surface drying produced least. Riffles were much more productive than pools in spring-fed streams and in larger tributaries; but in streams subject to surface drying, pools produced almost twice as much as did riffles. No satisfactory sampling technique was developed for deep pools in the larger tributaries; samples were confined to marginal areas of 14-inch depth or less. Diptera, mostly Chironomidae, were dominant in both riffles and pools in all streams studied. Ephemeroptera were subdominant in both pools and riffles in spring-fed streams and tributaries and in pools of streams subject to drying. Plecoptera were subdominant in riffles of the latter. Site clearing drastically reduced bottom fauna but was followed by rapid recovery. Bottom organisms were most abundant in water temperatures below 65° F. (Authors)

8375. Ingle, David J. (Dept. of Psychology, Mass. Inst. Tech., Cambridge). 1965. INTEROCULAR TRANSFER IN GOLDFISH: COLOR EASIER THAN PATTERN. Science, 149(3687): 1000-1002.

Goldfish were trained to monocularly discriminate different patterns that also differed in color. When tested with reversed combinations of color and pattern cues, the fish responded on the basis of pattern while using the trained eye but on the basis of color while using the untrained eye. Interhemispheric transfer of color information was therefore more effective than that of pattern. (Auth.)

8376. Hara, Toshiaki J., Kazuo Ueda, and Aubrey Gorbman (Dept. of Zoology, Univ. of Washington, Seattle). 1965. ELECTROENCEPHALOGRAPHIC STUDIES OF HOMING SALMON. Science, 149(3686): 884-885.

When adult spawning salmon (Oncorhynchus tshawytscha, O. kisutch) arrive at the "home" pond, most regions of the brain are electrically inactive, but the olfactory bulbs and posterior cerebellum are relatively highly active. Infusion of various natural waters from nearby sources other than the home pond into the olfactory sac produces little or no change in spontaneous electroencephalographic patterns recorded from the olfactory bulbs. Water from the home pond, however, produces a vigorous response of high amplitude. These findings suggest that olfaction is an important factor in guidance during the final phases of homeward migration of salmon, and that olfactory discrimination occurs at the level of either the olfactory bulbs or the olfactory epithelium. (Authors)

8377. Eklund, Henning (U.S. Public Health Service, 433 W. Van Buren Street, Chicago, Illinois). 1965. STABILITY OF LAKES NEAR THE TEMPERATURE OF MAXIMUM DENSITY. Science, 149(3684): 632-633.

In deep lakes that are near the temperature of maximum density, stability is greatest when the decrease of temperature with depth is about one-half of the decrease in temperature of maximum density with depth. Observed temperature decreases in lakes under such conditions tend to follow the curve that produces greatest stability. (Auth.).

8378. Anonymous. 1966. GABIONS PROVIDE SOLUTION TO FISHERY MANAGEMENT DILEMMA. The Izaak Walton Magazine, 31(2): 10-11.

Brief discussion of the uses of wire mesh baskets for improvement of trout streams.

8379. Brooks, John Langdon, and Stanley I. Dodson (Biology Dept. Yale Univ., New Haven, Conn.). 1965. PREDATION, BODY SIZE, AND COMPOSITION OF PLANKTON. Science, 150(3692): 28-35.

In the predation by the normally marine clupeoid Alosa pseudoharengus ("alewife") upon lake zooplankton, the usual large-sized crustacean dominants (spp. of Daphnia, Diaptomus) are eliminated, and replaced by small-sized, basically littoral, species, especially Bosmina longirostris. The significance of size in food selection by planktivores as opposed to planktonic herbivores is examined, and it is proposed that all planktonic herbivores utilize small organic particles (1 to 15 μ). The large species, more efficient in collecting these small particles and capable of collecting larger particles as well, will competitively exclude their smaller relatives whenever size-dependent predation will eliminate the large species, and the relatively immune small species will predominate. These antagonistic demands of competition and predation are considered to determine the body size of the dominant herbivorous zooplankters. (Authors summ.)

8380. Johannes, R. E., and Kenneth L. Webb (Univ. of Georgia Marine Inst., Sapelo Island, Ga.). 1965. RELEASE OF DISSOLVED AMINO ACIDS BY MARINE ZOOPLANKTON. Science, 150(3692): 76-77.

Marine net zooplankton release dissolved amino acids into the water. Release rates are positively correlated with temperature and can be estimated by the equation: Release rate (milligrams of alpha-amino nitrogen per gram dry weight of zooplankton per day) = 1.0 x temperature (°C) — 5.9. Release rates appeared to be independent of the taxonomic composition of the test samples, which were variously dominated by copepods, salps, chaetognaths, coelenterates, or radiolarians. These amino acids constitute an important source of dissolved organic matter in the sea. (Authors)

8381. McFarland, William N., and Frederick W. Munz (Div. of Biological Sciences, Cornell Univ., Ithaca, N. Y.). 1965. CODOMINANCE OF VISUAL PIGMENTS IN HYBRID FISHES. Science, 150(3699): 1055-1057.

Visual pigments of lake char and brook char (Salmonidae) are based on two different proteins. Both proteins are present in first-generation hybrids between these species and they segregate in second-generation and backcross hybrids, as expected of a single-factor difference. This first genetic study suggests that shifts observed in the absorption spectra maxima of visual pigments are related to substitutions of amino acids in the visual proteins. (Authors)

8382. Fox, Denis L., and Karl P. Kuchnow (Dept. of Marine Biology, Scripps Inst. of Oceanography, La Jolla, Calif.). 1965. REVERSIBLE, LIGHT-SCREENING PIGMENT OF ELASMOBRANCH EYES: CHEMICAL IDENTITY WITH MELANIN. Science, 150(3696): 612-614.

8383. Hayes, Jim. 1966. THE KOKANEE COME EAST. Outdoor Life, 137(6): 31, 109, 110, 112, 113.

Lists waters in New York, Connecticut, Pennsylvania, and North Carolina where landlocked sockeye salmon have been successfully introduced. Describes productive methods of catching these fish.

8384. Hoffarth, Ray, and John Conder. 1965. STATUS OF THE BAIT MINNOW IN TENNESSEE, 1963-64. Proc. Tennessee Acad. Science, 40(2): 71.

Seventy-eight minnow dealers were contacted by personal interview including 39 hatchery operators, 33 wholesalers, and 6 retailers. The current trend is toward importation of minnows from other states, where they are available at

lower production costs. Today's popular size minnow retails for 35¢ per dozen as compared to 55¢ per dozen in 1952. Total minnow sales increased from 52,734,505 in 1952 to 77,606,858 in 1964. In most cases, diseases, are being controlled effectively. Aquatic weeds are a continuous problem in Tennessee hatcheries. A study should be conducted to evaluate the effect of the Stickleback on present fish populations in Tennessee. (Abstract of paper presented at the 74th meeting of the Tennessee Academy of Science).

8385. Tibbs, J. (Dept. of Biochemistry, Queen's College, Univ. of St. Andrews, Dundee). 1965. EFFECT OF ADENOSINE TRIPHOSPHATE ON Perca fluviatilis SPERM TAILS ISOLATED IN BUFFERED SUCROSE. Biochemical Journal, 96(2): 340-346.

Sperm tails were isolated from mechanically disrupted spermatozoa of Perca fluviatilis and suspended in buffered sucrose solution. When freshly prepared suspensions were treated with ATP and magnesium chloride and centrifugal pellets obtained these weighed up to about 40% heavier than controls. The effect is closely linked to the enzymic splitting of ATP and under conditions where this was inhibited no increase in weight was observed. Pellets from suspensions aged overnight at 2° and then treated with ATP and magnesium chloride were no heavier than the controls although the suspensions had undiminished enzymic activity. Sperm tails from Salmo trutta did not show the effect. Analyses showed that the weight increases were the result of uptake of sucrose solution and that sucrose completely penetrated the pellet water. Polyethylene glycol (mol. wt. 4000) did not penetrate the water of the pellets completely and an amount approximately equal to 1·9 times the flagellar dry weight was inaccessible. Electron-microscopic studies indicated that the effect is the result of tail disintegration. (Auth.)

8386. Zurbuch, Peter E. (West Virginia Dept. Natural Resources, Elkins). 1963. DISSOLVING LIMESTONE FROM REVOLVING DRUMS IN FLOWING WATER. Transactions American Fisheries Society, 92(2): 173-178.

The low cost of raw limestone is a major advantage in its use as an alkaline neutralizing agent for acid streams. A study of acid water treatment was conducted in the Otter Creek drainage in the Monongahela National Forest, West Virginia. Most of the drainage is acid (less than pH 5.5), and most of the 12 miles of main stream and tributaries are not suitable for fish production. Electrical shocking and use of rotenone revealed no fish in Otter Creek from and including Condon Run downstream, including tributaries, to Moores Run. A native brook trout (Salvelinus fontinalis) population exists above Condon Run in the main stream. Bottom fauna are nearly nonexistent in the fishless sections. The treatment station was installed with an applicator drum constructed of 14-gauge steel with ends of 3/8-inch steel. The drum holds 1,800 pounds of No. 3 (average 1.5 inches maximum dimension) crushed limestone. At this capacity load there is proper space for agitation of the stone. Attrition of the limestone aggregate is achieved by tumbling it in the drum rotated by the stream flow. Drum revolutions vary with flow and limestone load. The study stream turned milky immediately below the treatment station, but most of this disappeared within the first 400 feet. After a period of prolonged treatment, two native brook trout were observed in water not formerly found inhabited. One was seen immediately below the treatment station and the other was observed moving downstream 1,000 feet below. Shortly after these observations, four live boxes, each containing five hatchery brook trout, were placed in the stream —two above the treatment site and two in the treated water. The pH of the untreated water was 4.9, and of the treated water, 7.9. After 3 days all brook trout in untreated water were dead. Only one was dead among those in the treated water. The surviving brook trout were held in the treated water for an additional 11 days without further mortality.

8387. Ritchie, Douglas E. (Univ. of Maryland, Chesapeake Biological Laboratory, Solomons, Md.). 1965. SEX DETERMINATION OF LIVE STRIPED BASS, Roccus saxatilis (Walbaum), BY BIOPSY TECHNIQUE. Chesapeake Science, 6(3): 141-145.

There is no practical and exact way of telling the sex of the striped bass, Roccus saxatilis (Walbaum), from external characteristics since this species does not exhibit sexual dimorphism, except when they are running ripe. A method of gonadal biopsy is described here whereby a tissue specimen of the gonad is obtained from a live fish for sex determination. A pair of serrated alligator-jawed forceps is used as the tool for obtaining the gonadal tissue via the sterile urogenital tract. The method was tested on two age groups of fish, ages II and III, in conjunction with the use of a nylon-streamer tag. The results of a duplicated test series show that in the laboratory correct tissue sampling was attained in 19 or 20 tries (95%) and sex identification was 100% correct in age III and 89% correct in age II. Only 3 of 20 biopsied fish were found to have unhealing gonad excision sites at autopsy. A mixed hierarchial model analysis of variance indicated near significant differences in survival time at the 5% level among the three sub-groups of fish, i.e., biopsied and tagged, tagged only, and control. (Auth.)

8388. Sprague, J.B., P.F. Elson, and R.L. Saunders (Fisheries Research Board of Canada, Biological Station, St. Andrews, N.B., Canada). 1965. SUBLETHAL COPPER-ZINC POLLUTION IN A SALMON RIVER — A FIELD AND LABORATORY STUDY. Internatl. Jour. Air Water Pollution, Vol. 9, pp. 531-543. Pergamon Press, London.

Pollution from a base metal mine developed in the Northwest Miramichi River, New Brunswick, Canada, where Atlantic salmon had been studied for ten years. Research was expanded to determine "safe" levels of copper and zinc. First apparent effect was avoidance by migrating adult salmon. A salmon counting-fence showed that 10-22 percent of ascending salmon returned downstream during four years of pollution, compared with 1-3 percent before pollution. Tagging showed that one third reascended later but most did not appear in any river system. Incipient lethal levels (ILL) for young salmon in the laboratory were 48 μg/l of copper or 600 μg/l of zinc in soft water. In equitoxic mixtures the ILL was additive. Bioassays in the polluted tributary showed general agreement. Salmon parr in the laboratory avoided less than one tenth of incipient lethal levels. Mixtures showed modest potentiation in causing avoidance. Avoidance thresholds were 0.09 ILL of zinc, 0.05 ILL of copper, or 0.02 ILL of equitoxic copper-zinc mixtures, added to the experimental water. Avoidance thresholds were higher in nature, abnormal downstream movements past the counting-fence occurring when pollution exceeded 0.35-0.43 ILL. Young salmon populations were severely depressed every year in the polluted Miramichi. Low supply of eggs and poor survival rates were both contributory causes. Lethal or near-lethal periods of pollution occurred most years, whereas young salmon must live successfully in the river for three successive years. Aquatic invertebrates indicate severity of copper-zinc pollution. Caddisflies and certain midges tolerate at least 1.5 times the ILL for salmon. Mayflies are more sensitive and undiminished numbers indicate non-lethal levels of metal pollution for young salmon. (Authors)

8389. Pillay, T.V.R. 1965. A BIBLIOGRAPHY OF BRACKISH-WATER FISH CULTURE. Food and Agriculture Organization of the U.N., Fisheries Circular No. 21, Rome, Italy. 20 p.

Listed are references on the culture of fishes, prawns and shrimps. Papers on the culture of euryhaline fishes in fresh waters have been omitted, but those relating to the propagation of marine fishes (not transplantings or "holding" before marketing) have been included in view of their direct significance in the culture of fishes in brackish-water environments. (Auth.)

8390. Alikunhi, K.H., K.K. Sukumaran, and S. Parameswaran (Central Inland Fisheries Research Sub-Station, Cuttack, India). 1962. INDUCED SPAWNING OF THE CHINESE GRASS CARP, Ctenopharyngodon idellus (C. & V.) AND THE SILVER CARP, Hypophthalmichthys molitrix (C. & V.) IN PONDS AT CUTTACK, INDIA. Proceedings Indo-Pacific Fisheries Council, 10th Session. pp. 181-204.

The paper discusses sexual maturation in ponds of chinese carp (grass carp, silver carp, and bighead). Fertilizable eggs and viable milt were obtained by intramuscular injection of pituitary extracts, homoplastic, and heteroplastic using Indian carp as donors. Rate of hatching and subsequent survival and growth of the fry is described. (Authors)

8391. Jonas, R. E. E., and E. Bilinski (Fisheries Research Board of Canada Technological Research Lab., Vancouver, B. C.). 1965. KETONE BODIES IN THE BLOOD OF SALMONOID FISHES. Jour. Fish. Res. Bd. Canada, 22(4): 891-898.

The concentration of acetoacetate expressed as acetone in the blood of rainbow trout (Salmo gairdnerii) was generally in the range of 0.3-1.0 mg/100 ml and long periods of starvation did not appear to affect this level to any appreciable extent. In sockeye salmon (Oncorhynchus nerka) in the pre-spawning stage of migration the concentration of acetoacetate was within the range found for rainbow trout. Higher concentrations of acetoacetate, amounting to approximately 1.5 mg/100 ml of blood, were present in sockeye salmon at the spawning grounds. Rainbow trout, which had been exercised, yielded greater value for β-hydroxybutyrate, and it was shown that under these conditions lactic acid interfered with the determination of β-hydroxybutyrate. Starvation of rainbow trout did not affect the concentration of β-hydroxybutyrate to any appreciable extent. In spawning salmon β-hydroxybutyrate showed some increase, as compared with fish in the pre-spawning stage of migration. (Authors)

8392. Swift, D. R. (Freshwater Biological Assoc., Far Sawrey, Ambleside, Westmorland, England). 1965. EFFECT OF TEMPERATURE ON MORTALITY AND RATE OF DEVELOPMENT OF THE EGGS OF THE WINDERMERE CHAR. Jour. Fish. Res. Bd. Canada, 22(4): 913-917.

Rate of development and mortality of eggs of the Windermere char (Salvelinus alpinus willughbii) were investigated. Excessive mortality occurred at temperatures above 8° C, total mortality above 12° C. Rate of development varied with the water temperature, eggs taking on an average of 45 days to hatch at 10° C and 95 days at 4° C. (Auth.)

8393. Shapley, S. Philip, and Daniel M. Bishop. 1965. SEDIMENTATION IN A SALMON STREAM. Jour. Fish. Res. Bd. Canada, 22(4): 919-928.

Sediment was artificially added to a small southeastern Alaskan salmon stream. Observations in sedimented and control riffles indicate that the amount of sediment settling to the stream bottom decreases exponentially with distance downstream. The dissolved oxygen content of intragravel stream water remained high in sedimented riffles. The added sediment was removed from streambed gravels by fall freshets and floods. (Authors)

8394. Saila, Saul B., Donald B. Horton, and Richard J. Berry (Graduate School of Oceanography, Univ. of Rhode Island, Kingston). 1965. ESTIMATES OF THE THEORETICAL BIOMASS OF JUVENILE WINTER FLOUNDER, Pseudopleuronectes americanus (Walbaum) REQUIRED FOR A FISHERY IN RHODE ISLAND. Jour. Fish. Res. Bd. Canada, 22(4): 945-954.

A model of the life history of the winter flounder was constructed using empirical estimates of vital statistics. The initial stock weight of juveniles was determined by substituting trial initial stock weight values into equations which contained average values of growth and mortality coefficients until the observed value of the equilibrium yield was approximated. Model data indicated that the stock weight of juvenile winter flounder at an age of 5 months constituted a significant proportion of the equilibrium yield even with conservative estimates of model coefficients. Growth appeared to be sufficiently rapid during early life-history stages to provide for a large increase in biomass in spite of considerable natural mortality. (Authors)

8395. Martin, N. V., and L. J. Chapman (Ontario Dept. Lands & Forests, Maple, Ontario, Canada). 1965. DISTRIBUTION OF CERTAIN CRUSTACEANS AND

FISHES IN THE REGION OF ALGONQUIN PARK, ONTARIO. Jour. Fish. Res. Bd. Canada, 22(4): 969-976.

Senecella calanoides, Limnocalanus macrurus, Mysis relicta, Pontoporeia affinis, and Myoxocephalus quadricornis were found in 63 lakes in the Algonquin Park region of Ontario. Their distribution results from direct coverage by glacial Lake Algonquin, outlet channels from this lake and Nipissing Great Lakes to the Ottawa valley, and inundation by the Champlain Sea. Their occurrence in 12 high-altitude lakes resulted from their transport to these waters by proglacial lakes. (Authors)

8396. Pycha, Richard L., and William R. Dryer (Bur. Commercial Fisheries Biological Lab., Ann Arbor, Mich.). 1965. MOVEMENTS OF HATCHERY-REARED LAKE TROUT IN LAKE SUPERIOR. Jour. Fish. Res. Bd. Canada, 22(4): 999-1024.

The history of stocking of lake trout (Salvelinus namaycush) in the Great Lakes is reviewed. The study of movements is based on capture of 24,275 fin-clipped lake trout taken in experimental gill nets and trawls and commercial gill nets. Yearling lake trout planted from shore dispersed to 15-fath (27-m) depths in 3-1/2 hr. Most fish remained within 2 miles (3.2 km) of the planting site 2 months, but within 4 months some fish had moved as much as 17 miles (27 km). The highest abundance of planted lake trout was in areas 2-4 miles (3.2-6.4 km) from the planting site even 3 years after release. Distance moved and size of fish were not correlated. Dispersal of lake trout begins at planting and probably continues until the fish are mature. Most movement was eastward in southern Lake Superior and followed the counterclockwise surface currents. Movement to areas west of the Keweenaw Peninsula was insignificant from plantings in Keweenaw Bay and nil from other plantings farther east. Lake trout planted in the eastern third of the lake dispersed more randomly than those planted farther west. Few fish moved farther offshore than the 50-fath (91-m) contour. Lake trout planted in Canadian waters made insignificant contributions to populations in U.S. waters. (Authors)

8397. Groot, C., and W. L. Wiley (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C.). 1965. TIME-LAPSE PHOTOGRAPHY OF AN ASDIC ECHO-SOUNDER PPI-SCOPE AS A TECHNIQUE FOR RECORDING FISH MOVEMENTS DURING MIGRATION. Jour. Fish. Res. Bd. Canada, 22(4): 1025-1034.

The use of time-lapse photography in combination with sonar as a means of observing the sockeye salmon (Oncorhynchus nerka) smolt migration in a large lake is discussed. A description of the gear used is given with some examples of the type of information that can be derived from this technique. The scanning rate of the sonar equipment used, combined with time-lapse photography, resulted in a compression of time to $\frac{1}{288}$ when scanning at a range of 400 ft and to $\frac{1}{576}$ at a range of 800 ft. A 24-hr period may thus be viewed on film in respectively 5 and 2-1/2 min when projected at a speed of 24 frames/sec. This speeded-up process facilitates separation of moving targets from stationary ones, even in the clutter of surface and/or ground echoes. Although subject to all the usual vagaries of target identification which accompany use of all echo-sounding gear, analysis of the movies with a time-motion projector appears to give meaningful information on such parameters as the speed and direction of migration or movement, and the distribution of migratory activity throughout a 24-hr period. (Authors)

8398. Hartman, G. F. (Fish and Game Branch, Dept. of Recreation and Conservation, Vancouver, B.C., Canada). 1965. THE ROLE OF BEHAVIOR IN THE ECOLOGY AND INTERACTION OF UNDERYEARLING COHO SALMON (Oncorhynchus kisutch) AND STEELHEAD TROUT (Salmo gairdneri). Jour. Fish. Res. Bd. Canada, 22(4): 1035-1081.

Two similar salmonids, coho and steelhead, cohabit many coastal rivers of British Columbia. Field collections reveal that the distributions of underyearling coho and steelhead are similar along the length of these streams. However, the

micro-distribution of the two species is different. In spring and summer, when population densities are high, coho occupy pools, trout occury riffles. In autumn and winter, when numbers are lower, both species inhabit the pools. Nilsson (1956) stated that segregation (such as that shown by coho and trout in spring and summer) may be indicative of competition resulting from similar ecological demands. To test this hypothesis the distribution and behavior of coho and steelhead were compared in a stream aquarium at different seasons with gradients of light, cover, depth or depth/velocity, and in experimental riffles and pools. Distributions and preferences of the two species in the experimental environments were most similar in spring and summer, the seasons when segregation occurred in nature, and least similar in autumn and winter, the seasons when the two species occurred together in nature. Spring and summer segregation in the streams is probably the result of interaction which occurs because of similarities in the environmental demands of the species and which is accentuated by dense populations and high levels of aggressiveness. The species do not segregate in streams in winter because certain ecological demands are different, numbers are lower, and levels of aggressiveness are low. When the two species were together in the experimental riffle and pool environment, trout were aggressive and defended areas in riffles but not in pools; coho were aggressive in pools but less inclined to defend space in the riffles. These differences in behavior probably account for the distribution of trout and coho in natural riffles and pools. (Auth.)

8399. Eppley, Richard W., and Phillip R. Sloan (Marine Food Chain Research Group, Inst. of Marine Resources, Univ. of Calif, La Jolla). 1965. CARBON BALANCE EXPERIMENTS WITH MARINE PHYTOPLANKTON. Jour. Fish. Res. Bd. Canada, 22(4): 1083-1097.

Carbon budgets were prepared for eight species of marine phytoplankton organisms in culture and one natural red tide population during 5-hr experiments at 21° C and light intensity 0.07 cal/cm^2/min. Net cell carbon increase, dissolved organic carbon excretion, and respiration were each determined by two or more independent methods. In diatoms, net oxygen production gave higher estimates of carbon assimilation than did direct carbon measurements, which were not accounted for by excretion of dissolved organic matter. Carbon-14 assimilation agreed well with the increase in oxidizable particulate carbon and with decrease in dissolved CO_2 of the medium, the latter after correcting for excreted organic carbon. Dunaliella tertiolecta excreted a constant fraction of its assimilated carbon regardless of its physiological activity. In diatoms excretion increased as cells became physiologically inactive. Thalassiosira rotula excreted similar amounts of carbon in light and dark. In two other diatoms excretion increased on darkening. In these short-term experiments carbon-14 sometimes gave low estimates of excretion by diatoms probably because both labelled and nonradioactive compounds were released by the cells. (Authors)

8400. Becker, Clarence D., and Max Katz (Fisheries Research Inst., College of Fisheries, Univ. of Washington, Seattle). 1965. DISTRIBUTION, ECOLOGY, AND BIOLOGY OF THE SALMONID LEECH, Piscicola salmositica (Rhynchobdellae: Piscicolidae). Jour. Fish. Res. Bd. Canada, 22(5): 1175-1195.

Piscicola salmositica Meyer 1946 is widely distributed throughout the Pacific coast of North America from central British Columbia to northern California. Habitual ectoparasites of teleost fishes, these piscicolid leeches are ordinarily encountered in association with spawning adult salmon (genus Oncorhynchus) and other Salmonidae; the common name "salmonid leech" is therefore applied. Piscicola salmositica, in common with its teleost hosts, occurs in a characteristic lotic environment — streams with moderate to swift currents, generally low temperatures, high dissolved oxygen content, and gravelled beds. An annual cycle of abundance is evident. Salmonid leeches appear in early fall attached to their hosts as they ascend into hatchery and natural spawning areas. From late September to February, during a period of feeding, growth, and reproduction, the leech populations attain a great abundance. By late winter, subsequent to the death of their hosts, the leeches have become virtually nonexistent, apparently

as a result of high mortality among the mature individuals, some downstream displacement, and limited predation by sculpins (Cottus sp.). Only the small, immature leeches are believed to survive the summer and return attached to spawning salmon the following fall. During the period of abundance in Soos Creek, a western Washington study stream, the lengths of feeding leeches increased at a rate of 2-3 mm per week. Weight, in relation to length, was dependent upon the amount of salmon blood ingested. Reproduction of salmonid leeches in Soos Creek was correlated with low water temperatures. Breeding began in temperatures of about 12° C in October and continued during December and January even in temperatures dropping to 5° C. The leeches attained sexual maturity at a length of about 15 mm; mature individuals then copulated and fastened cocoons to the lower surfaces of stones in the streambed. Deposited cocoons were dark brown and averaged 1.4 by 1.2 mm. In the laboratory, the average rate of reproduction ranged from 1.6 to 2.5 cocoons per leech per day, but the largest leeches (23-30 mm) produced the greatest number of cocoons. One young leech developed in each cocoon, emerging at a length of about 5.3 mm. Complete embryonic development and hatching occurred in about 7 days. (Authors)

8401. Lawler, G.H. (Fisheries Research Board of Canada Biological Station, London, Ontario, Canada). 1965. FLUCTUATIONS IN THE SUCCESS OF YEAR-CLASSES OF WHITEFISH POPULATIONS WITH SPECIAL REFERENCES TO LAKE ERIE. Jour. Fish. Res. Bd. Canada, 22(5): 1197-1227.

Year-class strength varied markedly in whitefish (Coregonus clupeaformis Mitchill) populations, and the presence of unusually strong year-classes was evident in the commercial catch. Fluctuations in the catch characterized the Lake Erie fishery and the unusually high production in some years was attributed to the occurrence of strong year-classes in the fishery. The most outstanding year-class in Lake Erie originated in the spring of 1944 and resulted in the highest catches ever recorded in the year 1948 and 1949. The next strongest year-class occurred in 1936 and resulted in high production in 1940 and 1941. The 1926 year-class was relatively strong and was responsible for subsequent high production. Other peaks in production could not be attributed to the presence of strong year-classes, as no age composition data were available, but it was inferred that strong year-classes were responsible. The 1943 year-class was unusually successful in Lake Huron, Green Bay (Michigan), and the upper portion of Lake Michigan. There is some evidence that year-classes of above average strength may have occurred in Lake Huron in the past, but were not as prevalent or as striking as those that occurred in Lake Erie. The 1944 year-class was dominant in the Lesser Slave Lake whitefish catch. There is no evidence that unusually succussful year-classes have ever appeared in Lake Ontario, Lake Winnipeg, Great Slave Lake, or Heming Lake. The whitefish is at the southernmost limit of its distribution in Lake Erie and here environmental conditions, especially temperature, have become progressively unfavorable. The increase in the abundance of species accustomed to more southern warmer conditions was further evidence that the lake itself is becoming warmer at a rather rapid rate. In Lake Erie the above average strength of the 1926, 1936, 1944, and other year-classes which were considered strong cannot be explained on the basis of the size of spawning population, the number of hatchery-raised fry planted, nor on the effect of such conditions as wind, turbidity, precipitation, and water level. Embryonic development of the whitefish was restricted to a very narrow range of temperature, the optimum for development being close to 33° F (0.5° C). The occurrence and continued survival of this species is limited to waters which maintain a temperature close to the freezing point during development and hatching. It was concluded that spawning at temperatures above 43° F (6.1° C) is probably unsuccessful. In Lake Erie there was considerable variation in developmental temperatures from year to year, and only rarely did temperature conditions approach the optimum for embryonic development. Strong year-classes in Lake Erie resulted only when the following suitable set of temperature conditions prevailed: (1) fall temperatures should drop early to 43° F (6.1°C), the temperature below which most successful spawning occurs; (2) the temperature decrease to the optimum for development should

be steady and not fluctuating; (3) the spring temperature should increase slowly and late, thus providing a prolonged incubation period at near optimum developmental temperatures. In years that strong year-classes arose, spring temperatures began to rise 2 weeks to 1 month later than in years that whitefish year-classes were not unusually strong. Weak year-classes occurred when one or more of these conditions were adverse. As the whitefish is a cold-water species, it is to be expected that maximum reproduction (assuming other conditions favorable) will occur only when the water temperature approaches that of more northern lakes. If Lake Erie continues to warm, the environment will become even less conducive to coregonines and the residual population will be confined to the deep basin at the eastern end or become extinct. The question of why lower-than-average temperature conditions did not result in the establishment of dominant year-classes in neighboring Lakes Huron and Ontario in the same year that they occurred in Lake Erie was discussed; the conclusion is reached that while temperatures were probably favorable for producing good populations, other conditions for survival may have been unfavorable and the occurrence of successful year-classes was dependent on other factors peculiar to the individual lake. Some aspects of dominance, including the simultaneous occurrence of strong year-classes in several species of Lake Erie fish were discussed. It was suggested that, although the important concept of "critical" periods in the success of year-classes was of great significance, consideration be given to the possibility of conditions that may be more broadly favorable — in time and space. (Auth.)

8402. Crossman, E.J., and Keen Buss (Royal Ontario Museum, Univ. of Toronto, Toronto, Ontario, Canada). 1965. HYBRIDIZATION IN THE FAMILY ESOCIDAE. Jour. Fish. Res. Bd. Canada, 22(5): 1261-1292.

Of 11 possible hybrids of species in the family Esocidae, six were known from nature and they are reviewed. The occurrence of a seventh, Esox lucius X Esox americanus americanus, is recorded. Of 22 possible reciprocal combinations of these species, five were previously known, five are still unknown, and 12 are newly described here. These 12 are based on artificial hybrids of known gametic constitution. Data are given on: description (young and oldest material available); growth; fertility; vitality and meristics are compared with parent populations. The low level of interspecific sterility was surprising. Some interspecific sterility exists between the two largest (Esox masquinongy Mitchill, Esox lucius Linnaeus) and the two smallest (Esox americanus Gmelin) forms. Total sterility does not exist as artificially one or other of the reciprocals was successful in each cross, including Esox masquinongy X Esox americanus. The hybrids exhibited the blending and intermediate nature usual in fish hybrids but colour pattern seemed tied to a particular parent. In nature only certain species hybridize, but it would appear that incompatibility of gametes has proceeded only to a limited extent. Other factors such as distribution, habitat, size, and behavior may be preventing hybridization. (Authors)

8403. Davenport, D., and W.R. Harling (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C.). 1965. METHOD OF RAPID MEASUREMENT FOR LARGE SAMPLES OF FISH. Jour. Fish. Res. Bd. Canada, 22(5): 1309-1310.

The use of detachable, graduated, plastic strips in conjunction with a measuring board to measure large samples is described.

8404. Lawler, G. H. (Fisheries Research Board of Canada Biological Station, London, Ontario, Canada). 1965. THE FOOD OF THE PIKE, Esox lucius, IN HEMING LAKE, MANITOBA. Jour. Fish. Res. Bd. Canada, 22(6): 1357-1377.

The stomach contents of 29,477 northern pike (Esox lucius) captured mainly in gill nets at Heming Lake, Manitoba, between 1950 and 1962 were examined. The food consisted almost exclusively of fish: trout-perch (Percopsis omiscomaycus) and yellow perch (Perca flavescens). Other fish included common suckers (Catostomus commersoni), spottail shiners (Notropis hudsonius), sticklebacks (Eucalia inconstans and Pungitius pungitius), pike, burbot (Lota lota), whitefish (Coregonus clupeaformis), tullibee (Leucichthys sp.), yellow walleye (Stizostedion

vitreum), cottid (Cottus cognatus), and darters (Etheostoma nigrum). Among invertebrates were crayfish, mayflies, dragonflies, caddisflies, and leeches. Ducks, small mammals, and frogs formed an insignificant part of the diet. Seasonal variation in food content and annual variation in the degree of feeding were evident. Trout-perch were important as food items in May and June, the spottail shiner in July, the yellow perch in August and September, and stickleback between October and March. Coregonine fishes, important in the life-cycle of Triaenophorus crassus but of minor importance as pike food, occurred in higher concentrations in October. There appeared to be annual differences in the degree of feeding, possibly related to differences in temperature. The frequency of empty stomachs from pike caught by angling and in gill nets was approximately the same. No obvious differences were noted in feeding habits of male and female pike, but there were some minor differences in the food of pike from shallow and deeper water habitats. Over an 11-year period of intensive fishing, there did not appear to be any unusual changes in the food habits of pike. The size of the prey is related to the size of the pike. There is a marked increase in the number of small perch, trout-perch, and spottail shiners consumed by pike of increasing size. The possible effects of the predator (pike) on other prey species is discussed. Relative abundance and seasonal availability appeared to determine the incidence of prey consumed. The reduction in the average size of the pike appears to have had some effect on the survival of other species of fish. (Auth.)

8405. Gross, W. L., E. W. Roelofs, and P. O. Fromm (Dept. of Fisheries and Wildlife and Physiology and Pharmacology, Michigan State Univ., East Lansing). 1965. INFLUENCE OF PHOTOPERIOD ON GROWTH OF GREEN SUNFISH, Lepomis cyanellus. Jour. Fish. Res. Bd. Canada, 22(6): 1379-1386.

Four 6-week experiments were conducted to evaluate the effect of photoperiod on growth (total length and weight), food consumption, and food conversion efficiency by green sunfish. Fish were held at constant temperatures in light-tight aquaria under four photoperiods (8-hr constant; 16-hr constant; variable, increasing from 8 to 16 hr; and variable, decreasing from 16 to 8 hr). Growth, food consumption, and food conversion efficiency were all influenced by photoperiod. Food consumption varied directly with the amount of light to which fish were exposed. Fish growth and food conversion efficiency were closely correlated and were generally highest in the increasing, lowest in the decreasing, and intermediate in the two constant photoperiods, but higher in the longer daylength. The results suggest that photoperiod influences growth through increasing conversion efficiency and also possibly through stimulating food consumption. Varying daylength exerts a greater influence on fish growth than a constant daylength. Increasing photoperiod stimulates growth and decreasing photoperiod inhibits growth. This result suggests that the lack of growth of warmwater fish in fall when water temperatures and average daylength correspond to those of spring is largely due to the influence of decreasing daylength. (Authors)

8406. Margolis, L. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. PARASITES AS AN AUXILIARY SOURCE OF INFORMATION ABOUT THE BIOLOGY OF PACIFIC SALMONS (Genus Oncorhynchus). Jour. Fish. Res. Bd. Canada, 22(6): 1387-1395.

The value of data from parasitology in providing supplementary information about the food and feeding habits, the associated fauna (other than food organisms) in the freshwater habitat, the ocean distribution of specific stocks, the "homing" phenomenon, and the freshwater origin of anadromous Pacific salmon is demonstrated. (Auth.)

8407. Bilton, H. T., and W. E. Ricker (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. SUPPLEMENTARY CHECKS ON THE SCALES OF PINK SALMON (Oncorhynchus gorbuscha) AND CHUM SALMON (O. keta). Jour. Fish. Res. Bd. Canada, 22(6): 1477-1489.

Among 159 central British Columbia pink salmon that had been marked by removal of two fins as fry and had been recovered in commercial fisheries after

one winter in the sea, the scales of about one-third showed a supplementary or "false" check near the center of the scale, in addition to the single clear-cut annulus. This evidence from fish of known age confirms the prevailing opinion that such extra checks do not represent annuli, hence that the fish bearing them are in their second year of life rather than their third. Unmarked pink salmon from the same area, and some from southern British Columbia, had a generally similar incidence of supplementary checks. In both marked and unmarked fish the supplementary checks varied in distinctness from faint to quite clear. In a sample of scales of 14 double-fin marked chum salmon which were known to be in their 4th year, all fish had the expected 3 annuli, and 12 fish had a supplementary check inside the first annulus. (Authors)

8408. Brett, J. R. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. THE RELATION OF SIZE TO RATE OF OXYGEN CONSUMPTION AND SUSTAINED SWIMMING SPEED OF SOCKEYE SALMON (Oncorhynchus nerka). Jour. Fish. Res. Bd. Canada, 22(6): 1491-1501.

The relation of size (log weight, g) to metabolic rate (log O_2-uptake, mg O_2/hr) of sockeye salmon was found to have a continuous change in slope (0.78-0.97) with increasing activity at 15° C. The slope of the equation relating the 60-min sustained swimming speed (log speed, cm/sec) to length (cm) had a value of 0.50, demonstrating a rapid decrease in relative performance with increasing size. (Auth.)

8409. Foerster, R. E. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. EFFECT OF RETENTION OF SPERMATOZOA AND OVA OF SOCKEYE SALMON, Oncorhynchus nerka, IN WATER AND WITHOUT ADDITION OF WATER, ON FERTILITY. Jour. Fish. Res. Bd. Canada, 22(6): 1503-1521.

Viability of ova and of spermatozoa was retained after considerable exposure to water and to air before fertilization. Fertilization occurred when spermatozoa were held in water for 8 hr (10.9% ova fertilized) and in air for 72 hr (4.4%), and when ova were held in water for 28 min (3.4%) and in air for 96 hr (73.7%). Great variation in results suggested that little importance could be attached to the actual percentage of eggs fertilized. (Auth.)

8410. Parker, Robert R. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1965. ESTIMATION OF SEA MORTALITY RATES FOR THE 1961 BROOD-YEAR PINK SALMON OF THE BELLA COOLA AREA, BRITISH COLUMBIA. Jour. Fish. Res. Bd. Canada, 22(6): 1523-1554.

A two-stage experiment was designed to estimate natural mortality rates of pink salmon during their early (coastal) and later (oceanic) periods of sea life. Difficulty was encountered because of disproportionate representation of various stocks in the marked populations, the stocks being subject to dissimilar rates of exploitation. Several assumptions were made for which the error introduced could not be fully evaluated. Under these assumptions, the results indicate (approximate values) that 55.7 million fry, resulting from the 1961 Burke Channel-Bella Coola stocks brood year, entered the sea. Of these, 77% died during the initial 40-day period of life in the enclosed marine waters. The following stage, from the time of seaward migration to adult return, a period of about 410 days, 78% of the remaining population died. The adult return was subjected to a rate of exploitation of 0.85 which produced a catch of 2.5 million fish. The spawning escapement was approximately 450,000 fish. It is established that the rate of natural mortality during the initial short period was much more severe than that during the remaining period of sea life. (Auth.)

8411. Ellis, Derek V. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1966. SWIMMING SPEEDS OF SOCKEYE AND COHO SALMON ON SPAWNING MIGRATION. Jour. Fish. Res. Bd. Canada, 23(2): 181-187.

The speed at which sockeye and coho salmon swim while on spawning migration

through a river was determined by direct timing of individual fish over measured river sections and by measurement of opposing water velocities. Migration was accomplished by two locomotory patterns: dart and steady swimming. For steady swimming there was a critical opposing water velocity from 1.1 to 1.7 ft/sec (mean 1.4 ft/sec). Against currents slower than the critical range steady swimming to a maximum speed of approximately 3.4 ft/sec (1.7 body lengths (L)/sec) was sustained through the observation areas, but against currents faster than the critical range salmon broke into position-holding behaviour at intervals. The calculated inter-decile range of swimming speeds (excluding slowest 10% and fastest 10%) against water velocities below the critical range was 1.75-3.18 ft/sec (0.9-1.7 L/sec) for sockeye salmon and 1.70-3.14 ft/sec (0.9-1.7 L/sec) for coho salmon. These swimming speeds were below maximum sustained values which have been determined experimentally. (Auth.)

8412. Bilinski, E., and R. E. E. Jonas (Fisheries Research Board of Canada Vancouver Lab., Vancouver, B. C., Canada). 1966. LECITHINASE ACTIVITY IN THE MUSCLE OF RAINBOW TROUT. Jour. Fish. Res. Bd. Canada, 23(2): 207-220.

A radioactive tracer procedure for determination of the various lecithin hydrolysing enzymes, at a low level of activity, is described. The procedure involves the use of phospholipids labeled with C^{14} in the choline moiety as substrate and the measurement of radioactivity released in the various products of hydrolysis. The pathways of lecithin catabolism in trout muscle is via glycerylphosphorylcholine. Of the other possible routes of breakdown of lecithin, there was no indication for the activity of phospholipase C or D. Greater enzymic activity was present in the lateral line muscle than in the white muscle. The enzyme which is responsible for hydrolysis of lecithin to glycerylphosphorylcholine showed optimum activity in the vicinity of pH 7 did not require Ca++ for activity and was partially inhibited by Hg++. A lysolecithinase, showing similar properties, but having a comparatively greater activity, was also present in trout muscle. (Authors)

8413. Shelbourn, J. E. (Dept. of Zoology, Univ. of British Columbia, Vancouver, B. C., Canada). 1966. INFLUENCE OF TEMPERATURE, SALINITY, AND PHOTOPERIOD ON THE AGGREGATIONS OF CHUM SALMON FRY (Oncorhynchus keta). Jour. Fish. Res. Bd. Canada, 23(2): 293-304.

Underyearling chum fry from hatchery stock were held in fresh water and salt water at two different temperatures and under two different photoperiods and acclimated to these conditions for 40 days before testing started. Aggregations were greater in salt water than in fresh water ($p < .01$). Fish acclimated to cold water schooled more strongly than those acclimated to warm water but this effect was not considered statistically significant. There were no differences in intensity of aggregation due to photoperiod ($p > .05$). The significance of these findings is discussed in relation to life history of the fry. (Auth.)

8414. Withler, I. L. (Fish and Game Branch of the British Columbia Dept. of Recreation and Conservation, Victoria, B. C., Canada). 1966. VARIABILITY IN LIFE HISTORY CHARACTERISTICS OF STEELHEAD TROUT (Salmo gairdneri) ALONG THE PACIFIC COAST OF NORTH AMERICA. Jour. Fish. Res. Bd. Canada, 23(3): 365-393.

Steelhead enter spawning streams in the lower mainland of British Columbia throughout all months. Those ascending streams between November 1 and April 30 are termed "winter steelhead," while "summer steelhead" enter streams between May 1 and September 30. Cheakamus River is exceptional in that initial stream entry of winter steelhead is delayed until April 1, with most fish entering during April and May. Late entry is related to delayed freshet conditions within this stream. Almost twice as many female as male steelhead were angled. Comparison with trapping results suggests that sport fisheries select for females of anadromous rainbow trout populations. Repeat spawning of winter steelhead was found to range from 5.0% for fish from the Seymour River to 31.3% for Cheakamus

River. Repeat spawning among summer steelhead ranged from 4.4% (Seymour River) to 6.3% (Coquihalla River). Mean fork lengths of populations of winter and summer steelhead showed little variation (range 26.3-31.0 inches). Winter steelhead from the Cheakamus River were larger than fish from all other populations while summer steelhead from the Coquihalla River had the least mean length. In general, mean fork lengths of winter and summer steelhead were not greatly different, despite the 5-8 - month shorter term of saltwater residence of the latter However, variations in mean lengths of steelhead between different river systems may result from differences in duration of saltwater residence since mean lengths of these populations did increase with longer saltwater residence. Steelhead spent from 1 to 4 years in fresh water and from 1 to 4 years in salt water. Along the Pacific coast from central California to southern British Columbia, timing of initial stream entry showed little variation. Sex ratios were nearly 1:1. Incidence of repeat spawning decreased from south to north. Mean fork lengths of steelhead populations were greater in northern areas where fish spent more years in fresh and more years in salt water. (Auth.)

8415. Allen, George H. (Div. of Natural Resources, Humboldt State College, Arcata, Calif.). 1965. ESTIMATING ERROR ASSOCIATED WITH OCEAN RECOVERIES OF FIN-MARKED COHO SALMON. Trans. American Fisheries Society, 94(4): 319-326.

Errors associated with the recovery of fin-marked fish include "unauthentic" recoveries, duplication of marks, and fin regeneration. Establishing validity of recoveries has been difficult, especially for Pacific salmon marked by the excision of a single fin and recovered in samples from ocean troll fisheries. Studies of error were made for recoveries of coho salmon of the 1950 brood that were marked by fin excision, planted into Puget Sound (Washington) streams in 1952, and recovered mainly in coho salmon fisheries in 1953. The total number of recoveries was large in comparison to the maximum estimated number of recoveries from traditional sources of error. On this basis analysis of recoveries from ocean fisheries would not be precluded even though the absolute magnitude of error was not known. (Auth.)

8416. Becker, Clarence D., and Max Katz (Fisheries Research Inst., Univ. of Washington, Seattle). 1965. INFECTIONS OF THE HEMOFLAGELLATE, Cryptobia salmositica Katz, 1951, IN FRESHWATER TELEOSTS OF THE PACIFIC COAST. Trans. American Fisheries Society, 94(4): 327-333.

Infections of Cryptobia salmositica Katz, 1951, are common and widely distributed in freshwater teleosts of the Pacific coast from southern British Columbia to northern California. The hemoflagellates are reported from 16 species of fish, representing four families and including 10 new hosts. The most susceptible hosts, as indicated by the incidence and intensity of infection, are the pink (Oncorhynchus gorbuscha) and coho (O. kitsutch) salmon, the torrent (Cottus rhotheus) and coast-range sculpin (C. aleuticus), and the longnose dace (Rhinichthys cataractae). The infected fish are typical cold-water species, occurring only in streams of generally low temperatures, graveled beds, and moderate to swift flowing currents. In this natural environment, the fish are associated with Piscicola salmositica (Meyer, 1946), the only known leech vector of the hemoflagellates. It is suggested that but one distinct species, C. salmositica, occurs in the blood of the various teleost fishes in this geographically restricted area in association with a common vector. (Authors).

8417. Lowry, Gerald R. (Oregon State Game Comm., Corvallis). 1965. MOVEMENT OF CUTTHROAT TROUT, Salmo clarki clarki (Richardson) IN THREE OREGON COASTAL STREAMS. Trans. American Fisheries Society, 94(4): 334-338.

Movement of cutthroat trout in three small coastal streams was studied from October 1959 to December 1963. Upstream migrations of trout occurred from late October until March, with a maximum in December. Kelts returned downstream from December to April with the greatest numbers in January and February.

More than 90% of the downstream movement of immatures occurred in February, March, April, and May, with numbers being consistently greatest in April. Two-year-old immature fish dominated the run in the two larger streams, while 1-year-old immatures did so in the smallest stream. Small tributaries of the study areas were found to be very important to cutthroat trout reproduction. Young trout were noted to leave the tributaries at about 1 year of age. Trout 150 mm in length that had never left the study streams were found in a gravid condition near redd sites. (Auth.)

8418. Butler, Robert L. (Bur. Sport Fisheries and Wildlife, Coop. Fishery Unit, Pennsylvania State Univ., University Park). 1965. FRESHWATER DRUM, Aplodinotus grunniens, IN THE NAVIGATIONAL IMPOUNDMENTS OF THE UPPER MISSISSIPPI RIVER. Trans. American Fisheries Society, 94(4): 339-349.

Scale samples from fish taken during the years of 1944 through 1948 were used to analyze the freshwater drum fishery of the Upper Mississippi. Total and fishing mortality rates were calculated for heavily and lightly fished populations in the impoundment system of 26 dams. Mortality rates of drum from the northern section of the river were compared with those from the southern section. Weak year classes were formed during 1942, 1943, and 1945, and strong year classes were formed during 1941 and 1944. Strength of year class was directly related to air and water temperature during May but not to water stage during the spawning season. (Auth.)

8419. Johnson, Murray G. (Metropolitan Toronto and Region Conservation Auth., Woodbridge, Ontario, Canada). 1965. ESTIMATES OF FISH POPULATIONS IN WARMWATER STREAMS BY THE REMOVAL METHOD. Trans. American Fisheries Society, 94(4): 350-357.

The removal method was used to estimate the size and composition of fish populations in four warmwater streams in southern Ontario. The assumptions underlying the removal method and variability in the data were examined. Populations of 8 to 33 thousand fish per acre weighing 32 to 174 pounds per acre were estimated. Four of 22 species of fish encountered comprised two-thirds of the average standing crop of 120 pounds per acre. These four, the white sucker, Catostomus commersoni, blacknose dace, Rhinichthys atratulus, creek chub, Semotilus atromaculatus, and common shiner, Notropis cornutus, appeared to be the best able of all species to utilize both pools and riffles. Other species were associated with either pools or riffles and therefore, while locally abundant, had lower average standing crops in the characteristic pool-riffle habitat of the streams studied. (Auth.)

8420. Bouck, Gerald R., and Robert C. Ball (Dept. Fisheries and Wildlife, Michigan State Univ., East Lansing). 1965. INFLUENCE OF A DIURNAL OXYGEN PULSE ON FISH SERUM PROTEINS. Trans. American Fisheries Society, 94(4): 363-370.

Changes in the serum protein, as shown by electrophoretic analyses, appear to be correlated with changes in the environment of the organism. These changes may be associated with aquatic pollution. A diurnal oxygen pulse of 3 ppm for 8 hours per day for 9 days produced a significant stress pattern in the serum protein fractions of bluegills and largemouth bass, but did not change that of yellow bullheads. According to this study, the minimum oxygen level (for 8 hours) that will not adversely affect bluegills and largemouth bass is well above the generally proposed 3 ppm. (Authors)

8421. Cowell, Bruce C. (Dept. of Entomology and Limnology, Cornell University, Ithaca, N. Y.). 1965. THE EFFECTS OF SODIUM ARSENITE AND SILVEX ON THE PLANKTON POPULATIONS IN FARM PONDS. Trans. American Fisheries Society, 94(4): 371-377.

A method of constructing polyethylene barriers which effectively divided a pond into two similar areas is described. With this technique, replications of treatment plots and control plots can be made in the same pond, thereby eliminating

the problem of variability among ponds. A relatively new test statistic, sequential analysis, was adapted for research in aquatic weed control. This test statistic is extremely valuable in that it eliminates the necessity of pre-treatment sampling. Valid conclusions can be obtained more rapidly, and a larger number of experiments can be conducted during one season. Neither herbicide had any effect on the phytoplankton, and silvex was neither toxic nor inhibitory to zooplankton at concentrations of 2 ppm. Applications of 4 ppm sodium arsenite produced drastic reductions in zooplankton. Differences of between one and two orders of magnitude were observed when samples of rotifers from areas treated with sodium arsenite were compared with those from control of silvex-treated areas of the same pond. Similar comparisons of copepod-cladoceran samples showed differences which ranged from sevenfold to one order of magnitude. Such differences were not observed in any of the ponds where two control areas (untreated) were compared or where a control area and a silvex-treated area were compared. (Auth.)

8422. Weaver, Charles R. (Bur. Commercial Fisheries, Fish-Passage Research Program, Seattle, Wash.). 1965. OBSERVATIONS ON THE SWIMMING ABILITY OF ADULT AMERICAN SHAD (Alosa sapidissima). Trans. American Fisheries Society, 94(4): 382-385.

Although shad appear to be capable of swimming modest distances in relatively high velocities, even the lowest of four velocities tested might present a serious barrier for some shad if a passage of more than a few feet were required.

8423. Lambou, Victor W. (Oklahoma Fishery Research Lab., Univ. of Oklahoma, Norman). 1965. OBSERVATIONS ON SIZE DISTRIBUTION AND SPAWNING BEHAVIOR OF THREADFIN SHAD. Trans. American Fisheries Society, 94(4): 385-386.

The original range of the threadfin shad (Dorosoma petenense) is being expanded by acclimatization of the fish to more northern waters mainly to furnish forage for other fishes. Inasmuch as the introduction of threadfin shad to other waters is based partly on the assumption that this fish does not reach a large size, data on the size distribution of the threadfin shad collected from some Louisiana waters as well as some observations on their spawning behavior in Louisiana are presented. The size distribution of the specimens (size range: 1.0-5.0 inches in total length) from Lake Bistineau and Clear Lake are typical of Louisiana. The Bogue Falaya River specimens are the largest average size threadfin shad (size range: 6.0-8.0 inches in total length) observed by the author in Louisiana. It appears that under some conditions threadfin shad are capable of obtaining a larger average size than is normally believed. Extensive spawning activities from dawn to shortly after sunrise were observed. One or more females were usually flanked by several smaller males. All spawning activity stopped almost immediately as soon as the sunlight touched the water.

8424. Drummond, Robert A., and Ted D. McKinney (Colorado Game, Fish and Parks Dept., Fisheries Research Center, Fort Collins). 1965. PREDICTING THE RECRUITMENT OF CUTTHROAT TROUT FRY IN TRAPPERS LAKE, COLORADO. Trans. American Fisheries Society, 94(4): 389-393.

Although spawner escapement was not correlated with fry recruitment, the extent of the fry recruitment in most years did bear a direct relationship to the number of trout available to the fishery. Years of large fry recruitment tended to appear later as strong year classes in the spawning runs and harvest by fishermen. A significant correlation existed between snow-water content and fry recruitment within the snow-water range of 9 to 14 inches. Fry recruitment is inversely proportional to snow water within this range.

8425. Everhart, W. Harry, and Charles A. Waters (Maine Dept. of Inland Fisheries and Game, Orono, Maine). 1965. LIFE HISTORY OF THE BLUEBACK TROUT (ARCTIC CHAR, Salvelinus alpinus (Linnaeus)) IN MAINE. Trans. American Fisheries Society, 94(4): 393-397.

8426. Smith, Lloyd, L. Jr., and Robert H. Kramer (Dept. of Entomology, Fisheries, and Wildlife, Univ. of Minnesota, St. Paul). 1965. SURVIVAL OF WALLEYE FINGERLINGS IN CONIFER GROUNDWOOD FIBER. Trans. American Fisheries Society, 94(4): 402-404.

Experimental results substantiated earlier findings that survival of walleye fingerlings in conifer groundwood fiber decreased when dissolved oxygen levels were reduced.

8427. Narver, David W., and Michael L. Dahlberg (Fisheries Research Inst., Univ. of Washington, Seattle). 1965. ESTUARINE FOOD OF DOLLY VARDEN AT CHIGNIK, ALASKA. Trans. American Fisheries Society, 94(4): 405-408.

8428. Brown, Edward H. Jr., and Clarence F. Clark (Ohio Div. of Wildlife, Columbus). 1965. LENGTH-WEIGHT RELATIONSHIP OF NORTHERN PIKE, Esox lucius, FROM EAST HARBOR, OHIO. Trans. American Fisheries Society, 94(4): 404-405.

8429. Carlson, Clarence A. (Dept. of Zoology and Entomology, Iowa State Univ., Ames). 1966. EFFECTS OF THREE ORGANOPHOSPHORUS INSECTICIDES ON IMMATURE Hexagenia AND Hydropsyche OF THE UPPER MISSISSIPPI RIVER. Trans. American Fisheries Society, 95(1): 1-5.

Hexagenia naiads were readily handled in bioassay, but Hydropsyche larvae showed high mortality until handling was reduced by providing small screens on which they built cases. The screens could then be transferred readily. Hydropsyche larvae were much more sensitive to Co-ral and to Dylox than were bluegills, but the ratio of the 24-hour TL_m values of Malathion to Hydropsyche to bluegills was only about 1 to 10. Malathion was less toxic to Hexagenia naiads than to bluegills, and Co-ral and Dylox gave only about a 1 to 10 margin for Hexagenia compared with bluegills. (Auth.)

8430. Doudoroff, Peter, Gérard Leduc, and Carl R. Schneider (R.A. Taft San. Eng. Center, U.S. Public Health Service, Cincinnati, Ohio). 1966. ACUTE TOXICITY TO FISH OF SOLUTIONS CONTAINING COMPLEX METAL CYANIDES, IN RELATION TO CONCENTRATIONS OF MOLECULAR HYDROCYANIC ACID. Trans. American Fisheries Society, 95(1): 6-22.

Published indirect evidence indicating that the toxicity of solutions of complex metal cyanides to fish is a function of the concentration of molecular (not ionized) HCN is reviewed. The striking influence of pH on the toxicity of the nickelocyanide complex could be explained only by assuming that HCN is the toxic factor. Recent re-evaluation of the dissociation constant of the tetracyanonickelate (II) ion, which showed previously accepted values to be grossly inaccurate and the true value to be in close agreement with an estimate based on toxicological data and theory, has confirmed the above interpretation of toxicity test results. By means of a recently published method for determination of molecular HCN by gas-liquid chromatography, it was possible to demonstrate conclusively that this factor virtually alone determined the acute toxicity to bluegills of various solutions of simple and complex cyanides. Median immobilization times for bluegills in the solutions varied independently of total cyanide concentrations but were clearly related to molecular HCN levels. Two of three tested solutions containing the silver-cyanide complex proved exceptional; their toxicity produced symptoms strongly suggestive of heavy-metal poisoning and was deemed referable to toxicity of the complex anions or of silver cations. The presence of representative water pollutants tested did not impair the precision and accuracy of the HCN determinations. Changes in CO_2 content and pH of the medium occurring at gill surfaces had no appreciable influence on the toxicity of the nickelocyanide complex, presumably because dissociation is not very rapid. Thus, the analytical method used for determination of HCN was shown to be useful in waste disposal control. Its practical application in connection with water pollution problems is discussed. (Authors)

8431. Becker, David A., Robert G. Heard, and Perry Don Holmes (Dept. of Zoology, Univ. of Arkansas, Fayetteville). 1966. A PRE-IMPOUNDMENT SURVEY OF THE HELMINTH AND COPEPOD PARASITES OF Micropterus SPP. OF BEAVER RESERVOIR IN NORTHWEST ARKANSAS. Trans. American Fisheries Society, 95(1): 23-34.

A total of 489 bass were examined and 21 species of parasites were recovered, as follows: nine species of trematodes representing six families; one cestode; two acanthocephalans representing two families; four nematodes representing three families; two leeches representing one family; and three copepods representing three families. From 410 fish specimens taken from 25 collection sites along the White River drainage, 18 species of parasites were recovered; of these specimens all but one was parasitized by at least one species of parasite. Seventy-nine Micropterus salmoides were examined from three state fish hatcheries presently stocking Beaver Reservoir to determine if the preventative measures used were effective in eliminating ectoparasites. Of these, all but four were parasitized by one or more species of parasite for an overall infection rate of 95%. Eleven species of parasites were recovered from the hatchery fish, three of which were not present in the White River drainage. Posthodiplostomum minimum and Neoechinorhynchus cylindratus, respectively, were the most prevalent parasite species in all three of the hosts studied. Twenty-one selected surveys were compared with the present pre-impoundment survey to determine the frequency and geographical distribution of the parasite species recovered. A comparison made between the 1962 and 1963 collections revealed pronounced fluctuations in the percentage of infection of many parasite species. The distribution, prevalency, and host specificity of parasites, and the control of fish parasites with relationship to this study are discussed. (Authors)

8432. Uzmann, Joseph R., and John Douglas (Bur. Sport Fisheries and Wildlife, Western Fish Disease Lab., Seattle, Wash.). 1966. Clinostomum marginatum IN STEELHEAD TROUT (Salmo gairdneri) AND CUTTHROAT TROUT (Salmo clarki) IN A WESTERN WASHINGTON LAKE. Trans. American Fisheries Society, 95(1): 35-38.

Clinostomum marginatum (Trematoda: Clinostomatidae), the yellow grub parasite, was recorded in epizootic proportions from Lynch Lake, King County, Washington, in 1961 and 1962. The parasite larvae occurred principally in steelhead trout (Salmo gairdneri); cutthroat trout (S. clarki) were infected to a relatively minor degree. Fish and snail host populations were destroyed by rotenone and copper sulfate treatments. (Authors)

8433. Hirschhorn, George (Bur. Commercial Fisheries, Biological Laboratory, Seattle, Wash.). 1966. EFFECT OF GROWTH PATTERN AND EXPLOITATION FEATURES ON YIELDS OF PINK SALMON IN THE NORTHWESTERN NORTH PACIFIC. Trans. American Fisheries Society, 95(1): 39-51.

A "rational" scheme of pink salmon exploitation in the Northwestern North Pacific was described recently by T. Doi. The scheme includes a 4-month term of offshore exploitation and inshore harvests of one-half of the resulting return; additionally, an offshore wastage coefficient equal to 0.5° F was assumed and a monomolecular pattern of weight growth during the last 4 months at sea. In this paper, yields are compared under various sets of natural conditions, and conditions of fishing. Yield relations are examined by means of Doi's index of rationality of offshore fishing and an alternative measure (the highest admissible inshore yield under protection of a specified target escapement). Fishery-connected variables include duration of offshore fishing, wastage, and inshore-offshore distribution of effort, given spawner requirements ranging from 17 to 50% of the return when offshore fishing is absent. In terms of effort distribution, unique solutions were obtained which are optimal with respect to total yield and target escapement. (Auth.)

8434. Cole, Charles F. (Dept. Forestry and Wildlife Management, Univ. of Massachusetts, Amherst). 1966. VIRTUAL POPULATION ESTIMATIONS OF

LARGEMOUTH BASS IN LAKE FORT SMITH, ARKANSAS, 1957-60. Trans. American Fisheries Society, 95(1): 52-55.

The virtual population estimation provides a useful minimal estimation of population size where a creel census is operated to provide estimates of total annual harvest and age structure. The creel census was operated from August 1957 through June 1960 indicating an average annual harvest of 1,067 bass from the 525-acre reservoir. An average virtual population of 3,325 bass was estimated following the method of Ricker (1958). Estimated maximal utilization rate was 0.32 and average postrecruitment annual mortality was 0.38. (Auth.)

8435. Robson, D.S., and H.A. Regier (Biometrics Unit, Cornell Univ., Ithaca, N.Y.). 1966. ESTIMATES OF TAG LOSS FROM RECOVERIES OF FISH TAGGED AND PERMANENTLY MARKED. Trans. American Fisheries Society, 95(1): 56-59.

The annual rate r of tag loss may be estimated from observations on the proportion of tag retentions among recoveries of fish which were both tagged and permanently marked at the time of release. In samples recovered t years after release, the proportion of marked fish still bearing tags is assumed to be an estimate of r^t. Homogeneity of these t-year loss rates for different year classes may be tested by Chi-square, and the information from all samples may then be combined in the form of a maximum-likelihood estimator of r. Finally, a goodness-of-fit Chi-square may be calculated to test the assumption of a constant annual rate of tag loss. When applied to recapture data on lake whitefish in Georgian Bay, these tests failed to detect any errors in this simple model. (Authors)

8436. Smith, Lloyd L., Jr., Robert H. Kramer, and Donovan M. Oseid (Dept. of Entomology, Fisheries, and Wildlife, Univ. of Minnesota, St. Paul). 1966. LONG-TERM EFFECTS OF CONIFER-GROUNDWOOD PAPER FIBER ON WALLEYES. Trans. American Fisheries Society, 95(1): 60-70.

Walleye fingerlings (Stizostedion v. vitreum) were held in 0, 50, 100, and 150 ppm conifer-groundwood fiber at 65° F and 100% oxygen saturation for up to 190 days. Fish were contained in recirculating water-flow systems and fed daily; water and fiber suspensions were changed daily. At the end of the experiment, fish in fiber were 2 to 3% shorter in length and 6 to 11% lighter in weight than controls. Relative condition factor was unchanged. Routine metabolic rate of walleyes in 150 ppm fiber was 18% higher than controls and active metabolic rate was 15% lower. Number of mucous cells on gills of fish from 150 ppm fiber treatments was 38% lower than controls and hematocrit of fish held in fiber averaged 6% lower than controls. (Authors)

8437. Shetter, David S., and Gaylord R. Alexander (Michigan Dept. of Conservation, Lewiston). 1966. ANGLING AND TROUT POPULATIONS ON THE NORTH BRANCH OF THE AU SABLE RIVER, CRAWFORD AND OTSEGO COUNTIES, MICHIGAN, UNDER SPECIAL AND NORMAL REGULATIONS, 1958-63. Trans. American Fisheries Society, 95(1): 85-91.

Angling and trout population data are compared from two stream sections of the North Branch of the Au Sable River which were fished for alternate 3-year periods of normal regulations (7-inch size limit, 10-trout creel limit, any lure) and special regulations (9-inch size limit, 5-trout creel limit, artificial flies only). Results were: (1) Fishing pressure was reduced by 50% in special regulation sections. (2) Total catch of fish in the creel was reduced by elimination of fish between 7 and 9 inches. (3) Total catch of fish larger than 9 inches was not increased. (4) The catch per hour of fish larger than 9 inches was increased significantly in one special-regulation section, but fewer anglers were involved. (5) Postseason populations of adult trout were greater under special regulations, but nonangling mortality between seasons lowered these gains to normal levels; higher postseason adult populations did not increase reproduction significantly. (6) Trout larger than 16 inches were observed in the catch from normal waters as often as from the special waters. (7) Stream sections fished under normal rules provided the greatest total harvest in the creel and the greatest angler use. (Authors)

8438. Baptist, John P. (Bur. Commercial Fisheries Radiobiological Laboratory, Beaufort, North Carolina). 1966. UPTAKE OF MIXED FISSION PRODUCTS BY MARINE FISHES. Trans. American Fisheries Society, 95(2): 145-152.

Laboratory experiments were conducted to measure uptake of fission products by fish from water and from oral doses. Availability of fission products to the fish was curtailed considerably by the formation and settling of radioactive particles in the water and by sorption to abiotic surfaces. Spot, Leiostomus xanthurus, and Atlantic croaker, Micropogon undulatus, accumulated relatively low levels of radioactive material from seawater. Following a single oral dose, croaker assimilated a maximum of 14% in 4 hours, but 94% of the original dose was eliminated after 4 days. Bluefish, Pomatomus saltatrix, assimilated only 3% of the cumulative dose of mixed fission products administered in shrimp and meat on alternate days for 55 days. Of the amount assimilated from oral doses by croaker and bluefish, the largest concentrations were found in the internal organs. (Auth.)

8439. Eisler, Ronald, and Philip H. Edmunds (Bur. Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, New Jersey). 1966. EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH. Trans. American Fisheries Society, 95(2): 153-159.

Adult northern puffers, Sphaeroides maculatus, were exposed to graded concentrations of endrin, a chlorinated hybrocarbon insecticide, at 20° C, 24 °/oo salinity, and pH 8.0. All animals subjected to 10.0 ppb of endrin died within 24 hours. At concentrations of 1.0 ppb of endrin, or lower, no mortality occurred within 96 hours. Blood and tissue samples from fish surviving the 96-hour exposure were analyzed by photoelectric colorimetry and atomic absorption spectroscopy. Mean hemoglobin content and relative liver size of puffers exposed to endrin concentrations of 1.0, 0.5, 0.1, or 0.05 ppb were not significantly different from those of controls. Although we found no meaningful changes in levels of serum chloride, gamma-globulin, and uric acid, we did find that the concentrations of sodium, potassium, calcium, and cholesterol in serum were consistently higher in experimental animals than in controls. Moreover, concentrations of sodium, potassium, calcium, magnesium, and zinc in the livers of test animals were consistently lower than in those of the controls. Concentrations of the same cations in gill tissue fluctuated widely. Exposure to sublethal concentrations of endrin impaired liver function, as evidenced by the transfer of major cations from the hepatic tissue into the serum and by elevated serum cholesterol. (Authors)

8440. Anderson, Richard B., and W. Harry Everhart (Maine Dept. Inland Fish. and Game, Gorham). 1966. CONCENTRATIONS OF DDT IN LANDLOCKED SALMON (Salmo salar) AT SEBAGO LAKE, MAINE. Trans. American Fisheries Society, 95(2): 160-164.

A decline of the sport fishery for salmon has been associated with the application of DDT to control human insect pests around the shores of Sebago Lake. The average DDT contents of 10-salmon samples collected in 1962, 1963, and 1964 were 1.1, 3.2, and 1.8 ppm by total wet weight. Salmon belonging to age group III had average DDT contents of 1.2 ppm; age group IV, 8.0 ppm; and age group V, 8.8 ppm. Ovaries of III-year-old salmon had 0.87 ppm of DDT, while ovaries from IV- and V-year-olds had 6.0 ppm DDT. Data also include results of DDE assays and calculated DDT concentrations in the fat. DDT concentrations found in small samples of lake chubs, common shiners, smallmouth bass, American smelt, lake white fish, and brook trout are also reported. (Authors)

8441. Sanders, Herman O., and Oliver B. Cope (Fish-Pesticide Research Lab., Bur. Sport Fisheries and Wildlife, Denver, Colorado). 1966. TOXICITIES OF SEVERAL PESTICIDES TO TWO SPECIES OF CLADOCERANS. Trans. American Fisheries Society, 95(2): 165-169.

Laboratory bioassays were conducted with some chlorinated hydrocarbon insecticides, organophosphate insecticides, other insecticides and acaricides, and with herbicides to determine their relative toxicities and immobilization values for two species of daphnids, Daphnia pulex and Simocephalus serrulatus. Both

species are satisfactory bioassay organisms for the determination of a wide variety of pesticides, with D. pulex being the more sensitive. The organophosphate insecticides were generally more toxic than the chlorinated hydrocarbons to both species. DDVP was the most toxic compound investigated. DDT was the most toxic chlorinated hydrocarbon tested, and lindane the least. There was a wide range in the toxicity of hydrocarbons to D. pulex, with 48-hour EC_{50} values ranging from 0.36 to 460 ppb. DDT was 2.9 times more toxic at 50° F than at 80° F. Malathion was 8.8 times more toxic at 50° F than at 70° F to S. serrulatus. Endrin was 12 times more toxic than dieldrin to D. pulex. DDT was 2.6 times more toxic at 60° F to first-instar organisms up to 18 hours old than to 7-day-old organisms. (Authors)

8442. Bouck, Gerald R., and Robert C. Ball (Dept. of Fisheries and Wildlife, Michigan State Univ., East Lansing). 1966. INFLUENCE OF CAPTURE METHODS ON BLOOD CHARACTERISTICS AND MORTALITY IN THE RAINBOW TROUT (Salmo gairdneri). Trans. American Fisheries Society, 95(2): 170-176.

Blood characteristics and mortality were compared between rainbow trout which were captured by (1) angling with artificial lures, (2) electroshocking, and (3) seining. The hemoglobin concentration, erythrocyte sizes, plasma protein concentrations, and plasma protein fractions varied according to the method of capture. Mortality was negligible in the shocked and seined lots, but was above 85% in the hooked fish group. Mortality was delayed and the symptoms suggest progressive shock. Definite differences in behavior were noticed in the post-capture fish and included prolonged fasting (shocked and hooked fish), hyper-excitability (shocked fish), and lethargy (hooked fish). The authors believe that presently used methods of capturing and handling fish should be re-evaluated, particularly if the fish are to be used in toxicological or management studies. (Authors)

8443. Gill, Charles D., and Donald M. Fisk (Bur. Commercial Fisheries, Seattle, Washington). 1966. VERTEBRAL ABNORMALITIES IN SOCKEYE, PINK, AND CHUM SALMON. Trans. American Fisheries Society, 95(2): 177-182.

Radiographs of vertebral structures of 10,377 sockeye, 4,403 chum, and 4,777 pink salmon collected in 1958 to 1962 were examined to determine the frequency of occurrence of abnormal vertebrae in wild populations of mature Pacific salmon. Various types of deviations from the orderly processes of development or segementation that resulted in abnormal structures were classified as fusions or abnormalities. The frequency of occurrence of abnormalities in the vertebral column was tabulated by species, sampling locations, and year of sampling. Abnormalities were found in the vertebral columns of 2.8% of the sockeye, 3.3% of the pink, and 2.9% of the chum salmon. Differences in frequency of occurrence of abnormalities among the species were not statistically significant. In sockeye salmon, 47% of the abnormalities were in the caudal region and 42% in the abdominal region; in pink salmon, 39% were in the caudal and 49% in the abdominal region. (Authors)

8444. Shelton, J.M., and R.D. Pollock (Bur. Commercial Fisheries, Columbia Fisheries Program Office, Portland, Oregon). 1966. SILTATION AND EGG SURVIVAL IN INCUBATION CHANNELS. Trans. American Fisheries Society, 95(2): 183-187.

Fall-chinook salmon eggs in Abernathy incubation channel suffered as much as 85% mortality when 15 to 30% of the voids in the gravel beds were filled with sediment. With one 70-foot section of the channel used as a silt-settling basin, the mortality was reduced to 10% or less. We believe that a siltation control system consisting of a flushable sand trap and settling basin constitute the most economical means of reducing the amount of sediment entering this and similar channels. (Authors)

8445. Helle, John H. (Bur. Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1966. BEHAVIOR OF DISPLACED ADULT PINK SALMON. Trans.

American Fisheries Society, 95(2): 188-195.

Studies to show whether pink salmon (Oncorhynchus gorbuscha, Walbaum) will repeat their original choice of spawning area when captured and transported to another location were done in Olsen Creek, Prince William Sound, Alaska, in 1961, 1962, and 1963. Fish to be displaced were anesthetized with MS-222 (except in 1961 when no anesthesia was used) and marked with Petersen disk tags. Equal numbers of control fish were treated in an identical manner and left at the donor site. In 1961, 100 pink salmon were displaced from Olsen Creek beyond the entrance of the bay, a distance of more than 3 miles from the creek mouth. Of the 54 fish accounted for, 91% returned to Olsen Creek. In 1962 and 1963, the displacements were confined to Olsen Bay. Fish displaced "on-route" achieved a higher rate of return than fish displaced "off-route". Further, under conditions of extremely low stream flow, displaced fish did not return to their original choice of spawning area. When stream flows were normal or high, they showed a strong tendency to return to areas of their original choice. (Auth.)

8446. Becker, Clarence D., and Max Katz (Fisheries Research Inst., College of Fisheries, University of Washington, Seattle). 1966. HOST RELATIONSHIPS OF Cryptobia salmositica (Protozoa: Mastigophora) IN A WESTERN WASHINGTON HATCHERY STREAM. Trans. American Fisheries Society, 95(2): 196-202.

The periodicity, incidence, and intensity of infection of the hemoflagellate Cryptobia salmositica Katz, 1951, in freshwater fishes corresponds to the biological association between teleost hosts and rhynchobdellid vector: adult and young coho salmon (Oncorhynchus kisutch), the torrent sculpin (Cottus rhotheus), and the salmonid leech (Piscicola salmositica). Adult salmon and leeches occupy Soos Creek, a western Washington stream, only during the fall and winter months. The incidence and intensities of Cryptobia in the maturing salmon increase in response to the period that feeding and infected leeches are carried, and ultimately 80 to 100% of the spawning population acquire the parasites. Young cohos also become infected during the fall and winter, but the incidence is generally less than 5%; the overwintering fingerling population, including the few infected young, emigrates seaward in the spring. The incidence of Cryptobia in the resident sculpin population averages 60%, but significantly lower incidence and higher intensities occur in young fish, those less than 65 mm in length; the sculpins serve as reservoirs of Cryptobia in the study stream. (Authors)

8447. Yuen, Heeny S.H. (Bur. Commercial Fisheries Biological Lab., Honolulu, Hawaii). 1966. SWIMMING SPEEDS OF YELLOWFIN AND SKIPJACK TUNA. Trans. American Fisheries Society, 95(2): 203-209.

Five hundred ten measurements of swimming speeds of skipjack tuna (Euthynnus pelamis) from four schools and 33 of yellowfin tuna (Thunnus albacares) from one school were made from underwater motion-picture records obtained at sea. The relation of swimming speed to rate of tail beats is described for yellowfin averaging 51.9 cm long and for skipjack averaging 57.2 cm long. At similar rates of tail beats, yellowfin swam faster than skipjack when speed was measured in body lengths per second. Variations in the mean swimming speed of the schools of feeding skipjack were unrelated to body length. The difference between the swimming speeds of tunas observed during this study, which ranged from 0.5 to 14.4 body lengths per second (0.3 to 6.9 m per second), and higher speeds previously reported for tunas is discussed. (Auth.)

8448. Schumacher, Robert E. (Minnesota Conservation Dept., St. Paul). 1966. SUCCESSFUL INTRODUCTION OF Mysis relicta (Loven) INTO A MINNESOTA LAKE. Trans. American Fisheries Society, 95(2): 216.

Two small crustaceans were planted in a 500-acre lake where lake trout had been introduced. The small shrimp and amphipod are major components of the winter diet of young lake trout. The mysids have become established and further checks will be made to determine the success of the introduction of amphipod, Pontoporeia affinis.

8449. Applegate, Richard L. (Bur. Sport Fisheries and Wildlife, South Central Reservoir Investigations, Fayetteville, Arkansas). 1966. PYLORIC CAECA COUNTS AS A METHOD FOR SEPARATING THE ADVANCED FRY AND FINGERLINGS OF LARGEMOUTH AND SPOTTED BASSES. Trans. American Fisheries Society, 95(2): 226.

8450. Randall, D.J., L.S. Smith, and J.R. Brett (Biological Station, Fisheries Research Board of Canada, Nanaimo, B.C., Canada). 1965. DORSAL AORTIC BLOOD PRESSURES RECORDED FROM THE RAINBOW TROUT (Salmo gairdneri). Canadian Journal of Zoology, 43(5): 863-872.

Dorsal aortic blood pressures were recorded from unanesthetized, free-swimming intact fish by a previously described cannulation technique. Some cardiovascular and breathing changes during recovery from the operation and anesthesia are reported. Dorsal aortic systolic blood pressures of 38.7 ± 2.9 mm Hg were recorded from unrestrained intact trout (Salmo gairdneri). A limited study indicated that there were no variations in dorsal aortic systolic blood pressure with changes in oxygen consumption in quiescent fish. (Authors)

8451. Eales, J. G. (Dept. of Zoology, Univ. of British Columbia, Vancouver, B.C., Canada). 1965. FACTORS INFLUENCING SEASONAL CHANGES IN THYROID ACTIVITY IN JUVENILE STEELHEAD TROUT, Salmo gairdneri. Canadian Journal of Zoology, 43(5): 719-729.

Seasonal changes in thyroid cell height and radioiodide indices of thyroid activity (CR and T/S) were measured in yearling and 2-year-old steelhead trout held in freshwater. Cell height was high in yearlings in mid-June and in 2-year-olds in late April and May at parr-smolt transformation; in both it was low in late summer and moderately high in winter. CR and T/S were high both at parr-smolt transformation and in late summer, but were low in winter. Only at parr-smolt transformation did cell height and radioiodide indices agree. Two-year-old potential smolts were held from January to May under four controlled temperature and photoperiod regimes. These experiments revealed that at parr-smolt transformation, both rising temperature and lengthening photoperiod induced the characteristically high CR and T/S values, but that the tall cell height depended on the lengthening photoperiod. Cell height and T/S were measured in yearlings (non-migrants) subjected to similar regimes at the same season. T/S was uninfluenced by photoperiod but responded to rising temperature. Cell height responses were more complex and indicated involvement of other variables. In September, small yearlings possessed significantly higher T/S and CR values than did large yearlings. A relationship between thyroid function and body weight could explain seasonal changes not attributable to temperature or photoperiod. (Auth.)

8452. Strout, Richard G. (Dept. of Zoology, Univ. of New Hampshire, Durham). 1965. A NEW HEMOFLAGELLATE (GENUS Cryptobia) FROM MARINE FISHES OF NORTHERN NEW ENGLAND. Journal of Parasitology, 51(4): 654-659.

A new species of hemoflagellate is described from the blood of marine fishes of northern New England. This appears to be the first record of a biflagellate organism in the blood of marine fishes from the Western Hemisphere. The parasite, placed in the genus Cryptobia Leidy (Trypanoplasma, Laveran and Mesnil), differs morphologically from Trypanoplasma parmae Mackerras and Mackerras (1925), the only other named cryptobiid from the blood of marine fishes (Parma microlepsis from Australia) and also from Trypanoplasma borreli Laveran and Mesnil (1901) found in the blood of several species of freshwater fishes. The organism is named Cryptobia bullocki, sp. n. Cryptobia bullocki has been found in the blood of the winter flounder (Pseudopleuronectes americanus (Walbaum); smooth flounder (Liopsetta putnami (Gill); mummichog (Fundulus heteroclitus Linnaeus); and striped killifish (F. majalis Walbaum). Attempts were unsuccessful to transmit the flagellate to mice (Mus musculus Linnaeus); goldfish (Carassius auratus Linnaeus); frogs (Rana pipiens Schreber); mullet (Mugil cephalus Linnaeus); brook trout (Salvelinus fontinalis Mitchill); tomcod (Microgadus tomcod Walbaum); and the grubby (Myoxocephalus aeneus Mitchill).

8453. Wood, Langley (Virginia Inst. of Marine Science, Gloucester Point). 1965. A CONTROLLED CONDITIONS SYSTEM (CCS) FOR CONTINUOUSLY FLOWING SEAWATER. Limnology and Oceanography, 10(3): 475-477.

A system that will automatically process continuously flowing seawater to controlled specifications is described.

8454. Awakura, Teruhiko. 1964. ON THE PARASITIC GLOCHIDIUM OF THE FRESH-WATER PEARL MUSSEL, Marguritifera marguritifera (L.) ON SALMONID FISH. Scientific Reports Hokkaido Fish Hatchery No. 19, Nakanoshima, Sapporo, Japan. pp. 1-16.

This report concerns the parasitic glochidium of the fresh-water pearl mussel, Marguritifera marguritifera (L.) on the gills of salmonid fish in the Chitose River in Hokkaido. During parasitological observations on some fish and benthos to elucidate the microsporidian infection of salmonid fish in the Chitose River, the present writer fortunately found some ecology of the glochidia of the fresh-water pearl mussel and some physiological effects of the parasitic glochidia on fish. The spawning of fresh-water pearl mussels takes place from the middle of June to early August. The glochidia were observed in the marsupium of female mussels from the end of July to the middle of August. The glochidia lived only on the gill lamella of salmonid fish from early August to the end of September. The host fish were fingerlings of Oncorhynchus masou and Salmo gairdnerii irideus in the natural condition as well as in the breeding condition. The glochidia were found also on the gill lamella of fingerlings of O. keta, O. nerka and 2-year-old O. nerka. However, they were not observed on the gills of both young and mature fish of Tribolodon hakonensis hakonensis, Cottus nozawae and Barbatula toni oreas in the natural condition nor on the gills of young of Carassius auratus, Cyprinus carpio, T. hakonensis hakonensis, Pleoglossus altivelis and 2-year-old S. gairdnerii irideus in the breeding condition. The glochidia living on the gills were enclosed by the epithelium of gill lamella and showed metamorphosis and growth. The size of the glochidium when first found on the gill lamella of fish was 0.07mm to 0.09 mm in length and 0.06 mm to 0.08 mm in width. However, just before falling off, it was 0.44 mm to 0.46 mm long, 0.28 mm to 0.30 mm wide. The relationship between the length (X) and the width (Y) is shown by the following formula: $Y=0.0084+0.8420X-0.4171X^2$. The glochidia on the gill lamella of fish which were bred artificially, were more numerous than that of naturally bred fish, the number being 10,931 maximum and 4,801 mean in 2-year-old O. nerka, 375 maximum, 264 mean in the fingerlings of O. nerka and 2,137 maximum, 527 mean in the fingerlings of O. keta in the breeding condition; whereas in the natural condition, it was 118 maximum, 21 mean in the fingerling of O.masou, 76 maximum, 12 mean in the fingerlings of S. gairdnerii irideus. The hematocrit of the fish blood with most glochidia parasites was found to be a little higher than that of normal fish. This fact may indicate that the infected fish is in a suffocating condition and it is highly probable that the parasites bring about some physiological change in the host fish. (Auth.)

8455. Terao, Toshiro, Shiro Kikuchi, Masaaki Uchiyama, Sumio Kurahashi, Haruyoshi Matsumoto, and Haruzo Abe. 1964. STUDIES ON THE INTER-SPECIFIC HYBRIDS BETWEEN CHUM SALMON Oncorhynchus keta (Walbaum) AND KOKANEE SALMON O. nerka var. adonis (Jordan et McGregor). II. TRANSPLANTATIONS OF SALMONOID HYBRIDS TO LAKE SHIKOTSU AND LAKE OKOTAMPE. Scientific Reports Hokkaido Fish Hatchery No. 19, Nakanoshima, Sapporo, Japan. pp. 43-63.

Salmonoid hybridization was carried out with milt and ova between anadromous chum salmon (Oncorhynchus keta) caught from the Chitose River, a tributary of the Ishikari River and adult kokanee salmon (O. nerka var. adonis) caught from Lake Shikotsu, Hokkaido. The authors (1963) have reported that body growth of the reciprocal hybrids cultured in the ponds is found at least, in the first year, to be more rapid than that of their respective parental species. In order to make an ecological study on their growth, feeding habit, mortality and maturity in the field, fry of these reciprocal hybrids were released to two lakes, Lake Shikotsu

and Lake Okotampe, in years of 1963 and 1964. Body size and number of fry released to the lakes are presented in table form. The authors have succeeded to collect five specimens of the second year-age of chum salmon (female) X kokanee salmon (male) hybrid from Lake Shikotsu and twenty-one specimens of the first year-age of kokanee salmon (female) X chum salmon (male) hybrid from Lake Okotampe. Observations made on the body growth and some external and internal characteristics of these specimens are described in this paper. (Authors)

8456. Terao, Toshiro, and Sumio Kurahashi. 1964. STUDIES ON THE FISH-CULTURED FOOD (XIV) ON THE EFFECT OF THE INCORPORATION OF THE VITAMIN E COMPLEX IN THE DIET WITH THE CHUM SALMON FRY. Scientific Reports Hokkaido Fish Hatchery No. 19, Nakanoshima, Sapporo, Japan. pp. 89-93.

Vitamin E or α-Tocopherol is a fat-soluble vitamin that is essential for the health of animals. The biological functions of vitamin E have been summarized in these categories: as a fat-soluble physiological antioxidant, as a physiological synergist, and as a functioning portion of specific enzyme systems. α-Tocopherol is the only antioxidant that has been shown to be absorbed through the intestinal wall and deposited in the fat. Vitamin E has the ability to promote the activity of easily oxidized substances such as the carotenoids and vitamin A. Incorporation of vitamin E in the diet has been reported to increase liver deposition of vitamin A and to improve the growth. In cultured rainbow trout, Samegai Trout Hatchery (1961) reported on the effects of vitamin E. Iizuka and Yamazaki (1963) reported incorporation of vitamin E in the diet was the curatical action of "Watakaburi" disease on the eel. Vitamin E incorporated in a diet containing unsaturated fat resulted in reduced mortality to rapidly growing chum salmon fry.

8457. Ikematsu, Wataru, Yataroh Tanaka, Masanori Azeta, Shigeo Ehira, Hisako Morokuma, and Sunao Yamaguchi. 1963. THE TOXIC EFFECT OF PENTA-CHLOROPHENATE, A HERBICIDE, ON AQUATIC ORGANISMS. Bulletin of the Seikai Regional Fisheries Research Lab., Nagasaki, Japan. pp. 1-23.

A large number of fishes and shellfishes were killed suddenly on the coast of the Ariake Sea, Kyushu, during early July of 1961. The main cause of this phenomenon was assumed to be the toxic effect of a herbicide Sodium pentachlorophenate, PCP. The use of PCP in this area was expanded enormously since 1961. Soon after PCP was employed this year, a great deal of water overflowed from the rice fields and ran into the sea as a result of heavy rainfall (over 150 mm/day). Thus, a series of laboratory experiments on the toxic effects of PCP on marine and freshwater organisms were carried out from 1961 to 1962 in order to confirm the above assumption. The various lethal concentrations of PCP for the experimental animals and plants of different species were determined. The standard curves of PCP concentrations on bioassay were also obtained from two species of fishes, "Tobihaze" Periophthalmus cantonensis and "Medaka" Oryzias latipes. The reaction of fishes to PCP solution was examined in order to estimate the concentration at which point the experimental fishes began to discriminate and/or avoid it. Results of this study indicate that from the standpoint of coastal fisheries alone, the use of PCP should be avoided because of its strong toxic effects on aquatic organisms. Therefore, it is necessary to exploit a new herbicide which is less harmful. (Authors)

8458. Hayashi, Koichiro, Shigeo Kobayashi, Tokiro Kamata, and Hisao Ozaki. 1964. STUDIES ON THE VIBRIO-DISEASE OF RAINBOW TROUT (Salmo gairdneri irideus) I. THERAPEUTIC EFFECT OF THE NITROFURAN DERIVATIVES. Journal of Faculty of Fisheries, Prefectural Univ. of Mie, Japan, 6(2): 171-180.

In 1962-1963, several pathogenic and non-pathogenic bacteria were isolated from Vibrio-diseased rainbow trout (Salmo gairdneri irideus) at Samegai Trout Hatchery, Shiga Prefecture, Japan. Observations were made on the effectiveness of nitrofuran derivatives to inhibit the growth of the isolated strains and to prevent rainbow trout from the infection of the pathogenic Vibrio. The results obtained were as follows: Bacteriological examinations on the isolated pathogenic strains showed almost the same characters as those of the strains described by Hoshina

and other authors. Classification on the present Vibrio species was discussed comparing with the other virulent Vibrios which had been previously described. The rainbow trout weighing 100 to 150 g were killed by an inoculation of about 10^4 of the virulent Vibrio within two to six days at the water temperatures of 6 to 10° C. Growth of the causative Vibrio was inhibited by the addition of nitrofuran derivatives, at the concentration of 0.25 ppm of nitrofurazone, furazolidone, and Z-furan and of 0.1 ppm of AF_2 to culture solution. Non-pathogenic rod strains (Pseudomonas sp. and Aeromonas sp.) isolated together with the Vibrio from diseased tissues of rainbow trout were resistant to the nitrofuran derivatives except one strain. Rainbow trout which were fed with a diet containing 0.02% furazolidone for two weeks showed a high degree of resistance against a compulsory Vibrio infection. Any unusual symptoms on growth and/or health of the rainbow trout after prolonged oral administration of furazolidone for three months, were not recognized. In the fish body, around 0.25 ppm of furazolidone, which is able to inhibit the growth of the pathogenic Vibrio, was maintained. Accordingly, it is concluded that nitrofuran derivatives are effective agents for treatment and prevention of the Vibrio disease of rainbow trout. (Authors)

8459. Hayashi, Koichiro, Shigeo Kobayashi, Tokiro Kamata, and Hisao Ozaki. 1964. STUDIES ON THE VIBRIO-DISEASE OF RAINBOW TROUT (Salmo gairdneri irideus) II. PROPHYLACTIC VACCINATION AGAINST THE VIBRIO-DISEASE. Journal of Faculty of Fisheries, Prefectural Univ. of Mie, Japan, 6(2): 180-191.

The experiments were carried out to ascertain the prophylactic effect of vaccination against the Vibrio-disease of rainbow trout. Fish were immunized by oral route or injections with the multiple vaccines which were made of pathogenic and non-pathogenic strains isolated from the Vibrio-diseased rainbow trout. The degree of immunization of the fish was proved from their resistance against an artificial Vibrio infection as well as from the values of agglutinin titer in fish sera. The results obtained were as follows: Natural immunity against the infectious was demonstrated in the sera of rainbow trout following a prevalence of the Vibrio-disease during summer through autumn at the trout hatchery. However, this acquired immunity would not persist in several months. Natural antibodies against the non-pathogenic strains were also found. Agglutinin against the virulent strains was produced from after two weeks with the daily administration of oral vaccines, but its titer values did not rise to a significantly high level. The highest titer value attained by the concentrated vaccine was 128 at the end of four weeks oral administration. Remarkable response in agglutinin production by the oral vaccination to the non-pathogenic strains, especially to M-4 strain, was noticed. The titer reached to a value of 4096. Immunization by a series of injection of vaccine (once a week) was more effective with the maximum titer value of 512 than that by oral dosage (daily). Increased resistance of immunized rainbow trout against an artificial Vibrio infection was observed in the following effective order: (1) injection of vaccine, (2) oral dosage of conc. vaccine mixed with a diet, (3) feeding with a diet containing 1/50 vaccine. The fish which have higher agglutinin titer values in their sera, could stand against a stronger Vibrio attack. The evidence thus obtained supports the practical application of vaccines by injection or of heavy dose of oral vaccines for prophylaxis and control of the Vibrio disease. (Authors)

8460. Taub, Stephen H. (Ohio Coop. Fishery Unit, Ohio State Univ., Columbus) 1966. SOME ASPECTS OF THE LIFE HISTORY OF THE WHITE PERCH, Roccus americanus (Gmelin), IN QUABBIN RESERVOIR, MASSACHUSETTS. Unpublished Master's Thesis, Univ. of Massachusetts, Amherst. 63 p.

The age and growth, reproduction, food habits and parasitism of white perch in the Reservoir were investigated during a two year study. The rate of growth was most rapid during the first year of life, with a rapid decrease occurring after age group III. Annulus formation took place in late spring to early summer. The growing season ended in November. A sexual difference in growth rate, by age groups, was observed. This difference is attributed to males attaining sexual maturity at least one year prior to females. Data analysis revealed that the

present rate of growth of the reservoir's white perch population is rapid. Ten females had a mean fecundity of 271,000 ova, with a range of 190,000-321,000 eggs. The rate of incubation varied from 34-73 hours, depending upon exposure to varying light conditions and water temperatures. Fish were the most abundant food item found in the stomachs of yearling-plus white perch, followed by plants, insects and crustaceans in order of relative abundance. Crustaceans and dipteran larvae were the major food items found in the stomach contents of young of the year fish. In the fish examined for parasitism, 46 percent were infested with cysts of the nematode Eustrongylides sp. Infestation was usually light to moderate and the infested fish did not appear adversely affected. (Auth.)

8461. Kume, Susumu, and James Joseph. 1966. SIZE COMPOSITION, GROWTH AND SEXUAL MATURITY OF BIGEYE TUNA, Thunnus obesus (Lowe), FROM THE JAPANESE LONG-LINE FISHERY IN THE EASTERN PACIFIC OCEAN. Bull. Inter-American Tropical Tuna Commission, La Jolla, Calif., Vol. 11, No. 2, 99 p.

Size composition data of bigeye tuna taken from the eastern tropical Pacific Ocean by Japanese Prefectural experimental training vessels from 1958 to 1964 are examined. A gradient of increasing fish size from east to west is noted. Males increase in ratio over females for the entire range of lengths examined, and beyond 170 cm comprise more than 75 percent of the total. The first semester of the year is important as a bigeye spawning season. A general relationship between sexual maturity and thermal structure of the water is discussed. At the end of their 12th quarter of life bigeye are about 114 cm long, by the 16th quarter, 137 cm and at the end of 20 quarters, about 153 cm. The long-line fishery in the eastern Pacific has had a marked effect on the size composition of the stocks of bigeye, but whether the fishing has driven the stocks below a point which could afford a maximum sustainable yield could not be determined. (Authors)

8462. La Roche, Gilles, C. L. Johnson, and A. N. Woodall. (Donner Lab., Univ. Calif., Berkeley). 1965. THYROID FUNCTION IN THE RAINBOW TROUT (Salmo gairdneri, Rich.) I. BIOCHEMICAL AND HISTOLOGICAL EVIDENCE OF RADIOTHYROIDECTOMY. Gen Comp Endrocrinol 5(2): 145-159. Illus.

A procedure to obtain radiothyroidectomy in rainbow trout is presented in detail. Investigations of radioiodine turnover and stable iodine distribution furnish adequate evidence of the completeness of radiothyroidectomy when compared with similar studies in intact controls. Stable iodine contents in the thyroid gland of intact controls were ascertained and found to be proportional to the level of ingested iodine. In intact fish thyroidal radioiodine uptakes were shown to be dependent, as in homoiotherms, on the adequacy of dietary iodine. Total serum I^{127} levels were proportional to the amount of iodine in the diet. Serum protein-bound I^{127} levels were found to be independent of dietary iodine and of the presence or absence of thyroid tissue. Serum organically bound iodine in thyroidectomized animals is explained by peripheral iodination or iodide "binding". Histological examinations of serial sections of the thyroid regions, at various times after I^{131} administration, confirmed the disappearance of thyroid follicles. Results suggest that tyrosine iodination may occur in the absence of thyroid follicles. (Authors)

8463. Mulcahy, Marie F., and Fergus J. O'Rourke (Univ. Coll., Cork, Corkfordshire, England). 1964. CANCEROUS PIKE IN IRELAND. Irish Natur Jour., 14(12): 312-315. Illus. Map.; Biological Abstracts, 46(16): Abst. No. 71164. 1965.

A report of a relatively high incidence of neoplasms encountered in pike during a recent 10-year intensive eradication program in Irish lakes and rivers conducted by the Inland Fisheries Trust. The incidence has varied from 0.05/1000 in North County Mayo to 2.60/1000 in County Cavan, the latter county having had a 12.5% incidence in 300 fish closely examined. --G. Eder.

8464. Ogilvie, D. M., and J. M. Anderson (Dept. Zool., Univ. Western Ontario, London, Ontario, Canada). 1965. EFFECT OF DDT ON TEMPERATURE SELECTION BY YOUNG ATLANTIC SALMON, Salmo salar. Jour. Fish. Res. Board Canada, 22(2): 503-512. Illus.; Biological Abstracts, 46(17): Abst. No. 74008. 1965.

Exposure of Atlantic salmon underyearlings for 24 hr to sublethal doses of DDT, ranging from 5 to 50 ppb, resulted in changes in the selected temperature. Low doses produced a downwards shift in the selected temperature whereas higher doses produced an upwards shift. The DDT effect appeared to be more marked for warm-acclimated fish (17° C) than for cold-acclimated ones (8° C). In addition exposure of warm-acclimated fish to 10 ppb DDT or more appeared to make them extremely sensitive to cold water and there was some evidence to suggest that the lower lethal limit may have been raised. It is suggested that DDT may interfere with the normal thermal acclimation mechanism. (Authors)

8465. Paloheimo, J. E., and L. M. Dickie (Fish. Res. Board Canada, Biol. Sta., St. Andrews, N. B., Canada). 1965. FOOD AND GROWTH OF FISHES. I. A GROWTH CURVE DERIVED FROM EXPERIMENTAL DATA. Jour. Fish. Res. Bd. Canada, 22(2): 521-542. Illus.; Biological Abstracts, 46(17): Abst. No. 74009. 1965.

A general equation for growth of fishes is obtained through use of the relations among body weight, metabolic rate, and growth efficiency that have been found in laboratory experiments. The curves show an early inflection point and gradually decreasing growth rate thereafter, without a theoretical asymptote. When growth efficiency is constant this equation indicates that growth becomes nearly exponential and is fitted exactly by the Parker and Larkin (1959) equation. When growth efficiency decreases with increasing rations the curves having an asymptote, such as the von Bertalanffy curve, have often been fitted to growth data. When the estimated asymptote can be related to the inflection point of the early part of a growth phase, it is proportional to a physiological time scale suggested by the food-growth relations. Truly asymptotic growth would appear to result only from complex changes in metabolism, growth efficiency, or interactions with mortality of these results of food-growth experiments are discussed in relation to studies of biological productivity, especially their bearing on objectives of fisheries management. They suggest that, in general, highest sustained yield from a particular growth phase or stanza is obtained from a type of cropping which results in a population of fish having an average size near that of the smallest fish in the stanza. (Authors)

8466. Pearson, Roger E. (Biol. Lab., Bur. Commercial Fisheries, Seattle, Washington). 1964. USE OF A DISCRIMINANT FUNCTION TO CLASSIFY NORTH AMERICAN AND ASIAN PINK SALMON, Oncorhynchus gorbuscha (Walbaum), COLLECTED IN 1959. Int N Pacific Fish Comm Bull 14. 67-90, Illus.; Biological Abstracts, 46(17): Abst. No. 74010. 1965.

A discriminant function analysis with six morphological characters was used to determine the continental origin of pink salmon (Oncorhynchus gorbuscha) taken from the Bering Sea and North Pacific Ocean in 1959. The spawning regions of eastern Kamchatka and western Alaska were assumed to be the destination of the pink salmon taken on the high seas. Consequently, morphological characters taken from eastern Kamchatkan and western Alaskan fish were used to compute continental morpho-types. Applying the function, pink salmon populations from all North American inshore areas were well separated from the eastern Kamchatkan morphotype. Alaskan morphotype fish were dominant in the two high seas samples taken at longitude 160°W. in the North Pacific Ocean, in one sample taken at longitude 177°W, in the North Pacific Ocean, and in one sample taken at longitude 179°W. in the Bering Sea. Eastern Kamchatkan morphotype fish were dominant in all other seas samples taken at longitude 170°W. and to the westward. No high seas samples were taken between longitudes 170°W. and 160°W. (Auth.)

8467. Petrenko, L. A. (State Res. Inst. Lake Fish., Leningrad, USSR). 1964. A COMPARATIVE CHARACTERIZATION OF THE GROWTH OF WILD AND POND-

RAISED YOUNG SALMON (Salmo salar L.) IN A RIVER. Vop Ikhtiol 4(2): 342-347. Illus.; Biological Abstracts, 46(17): Abst. No. 74011. 1965.

Pond-raised salmon that were released (after tagging) from the Kandalaksha hatcheries into the Luvenga River in 1959-60 and recaptured in 1960-61 at ages 1+ and 2+ exhibited the same growth rate as did wild Luvenga salmon of similar age range. In both wild and pond-raised fish, weight gain was greater at the beginning of summer and middle of fall than at the end of summer. Body length in all size groups increased relatively uniformly through the summer months. A decrease in growth rate, observed in July and August, was correlated with high water temperatures and a more active mode of life. A description of the tags used for the marking of individual fishes is presented, and the method of tagging is described. --D. M. Cutler.

8468. Blair, A. A. (Fish. Res. Board Canada, Biol. Sta., St. John's, Newfnld., Canada). 1965. BAY OF ISLANDS AND HUMBER RIVER ATLANTIC SALMON INVESTIGATIONS. Jour. Fish. Res. Board Canada, 22(2): 599-620. Illus.; Biological Abstracts, 46(17): Abst. No. 73973. 1965.

Humber River is one of the important Atlantic salmon rivers of Newfoundland both from the standpoint of the angling in the river and the commercial fishery at the mouth of the river in Bay of Islands. The fishery was investigated in 1942 and a general survey was made of the main river and its tributaries in 1943 to determine conditions for spawning. The sea-age classes of Bay of Islands salmon and their percentage composition were: 1, 57.2; 2, 32.8; 3, 0.5; and previously spawned, 9.5. The 1 sea-year or grilse class was less numerous in June than 2 sea-year class, but was more numerous during the rest of the season. The 3 sea-year class was not represented at all until August, whereas the previously-spawned class had a higher representation in the first half of June than it did later in the season. According to fishermen's reports, the time of the run of the older salmon is usually from the last week of May to the first week of August with the peak around June 15, whereas grilse are caught from June 15 to the last week in August with the peak during the first half of July. The river-age classes of Bay of Islands salmon and their percentage representation were: 2, 2.1; 3, 42.1; 4, 51.6; 5, 4.0; and 6, 0.1. The average river age was 3.6 years. The average size of grilse was 52.8 cm and 3.4 lb (1.54 kg), and that of the sea-age class 2 was 75.3 cm and 10.6 lb (4.81 kg). Four percent of the grilse and 28 percent of older salmon from Bay of Islands contained food; after July 22 no fish containing food was found. Capelin formed the predominant food item, and, almost always, the remainder was fish of other species. A survey of the main Humber River and its tributaries revealed a number of natural obstructions to the passage of salmon. A brief description of these is given, together with some suggestions for improvement. Access of anadromous salmon to Grand Lake and tributaries has been cut off by a dam. The lake now contains lake salmon, brook trout, and Arctic char. (Auth.)

8469. Conte, F. P. (Oregon State Univ., Radiation Center, Corvallis). 1965. DEVELOPMENT OF OSMOTIC AND IONIC REGULATION IN JUVENILE STEELHEAD TROUT Salmo gairdneri. Comp Biochem Physiol 14(4): 603-620. Illus.; Biological Abstracts, 46(17): 73976. 1965.

The development of the osmotic and ionic regulatory system during the juvenile phase of the life cycle was determined by measurements of survival, median lethal time, distribution pattern of mortalities and changes in osmotic, sodium and chloride concentration of the plasma following exposure to sea water (salinity = 30 $^{o}/_{oo}$). A temporal pattern in the development of seawater adaptation was observed. It preceded seaward migration and smolt transformation by several weeks. Regression of adaptation occurred during the terminal stages of the migration period. Seawater survival was shown to be a function of size and not chronological age. The age of the animal was important only from the standpoint of growth rate. Variability of the osmotic and ionic regulatory system was determined by measuring changes in blood concentration (i.e. m-osmol/l, Na^+ and Cl^-) during the pre-migratory, migratory and post-migratory periods. In

non-adapting individuals, sodium and chloride do not represent the 85-90% of the total osmotic concentration as found for freshwater fish. It suggests that other types of solutes may play a vital role in seawater homeostasis and/or in pathogenesis of seawater death. Thyroid activity was assayed by histological and radiochemical techniques during pre-migratory, migratory and post-migratory periods. Increased activity was found during the period of migration. Thyroid activity did not appear to be casually related toward seawater adaptation. (Authors)

8470. Lander, Robert H., and George K. Tanonaka. (Biol. Lab., Bur. Commercial Fish., Seattle, Washington). 1964. MARINE GROWTH OF WESTERN ALASKAN SOCKEYE SALMON (Oncorhynchus nerka Walbaum). Int N Pacific Fish Comm Bull 14. 1-31. Illus. Map.; Biological Abstracts, 46(17): Abst. No. 73995. 1965.

The study is based on weight, length, age and maturity data from individual sockeye salmon (Oncorhynchus nerka) taken by gillnets from 1956 through 1960 in the North Pacific Ocean and Bering Sea. Preliminary to estimating growth rates within and between certain marine life history stages, the effects of the following sources of variation are considered: (1) sex, maturity and winters at sea before capture, (2) continent of origin; (3) changes in size between time of capture and time of laboratory processing; (4) use of gillnets known to be selective for size; (5) area of capture; and (6) year of capture. Seasonal increases in average body weight of Western Alaskan sockeye salmon are found to be 30% for 1-winter immatures during 40 days in July-August, 22% for 2-winter immatures during 50 days in July-August, 13% for 2-winter maturing fish during 40 days in May-July, and 14% for 3-winter maturing sockeye salmon during 30 days in May-June. With average body weight of 1-winter immatures on August 3 as a reference, estimated long-term increases are as follows: 149% until July 30 the next year as 2-winter immatures, 247% until June 14 the next year as 2-winter maturing sockeye, and 382% until June 10 the second year later as 3-winter maturing sockeye. Between July 30 as 2-winter immatures and June 10 the following year as 3-winter maturing fish, average body weight of Western Alaskan sockeye salmon is estimated to increase by 94%. Percentage rates are converted to total and 30-day average instantaneous rates. Also discussed is the need for future research on short-term ocean growth and natural mortality rates of Pacific salmon, particularly as knowledge of these parameters relates to rationality of fishing salmon on the high seas. (Authors)

8471. Kerharo, J., F. Guichard, and A. Bouguet (Fac. Mixte Med. Pharm., Dakar, Senegal). 1962. ICHTHYOTOXIC PLANTS. III. SECOND PART OF AN INVENTORY OF FISH POISONS (CONCLUSIONS). Bull Mem Fac Mixte Med Pharm Dakar 10: 223-242; Biological Abstracts, 46(17): Abst. No. 75676. 1965.

The first part of this review appeared as an introduction, in volume 8 of this Bulletin, 1960; the second, as the first part of an annotated list of plants which stun or kill fish, in volume 9, 1961. The present concluding part contains an extensive index to this list which includes some 600 names of families and genera and species. The list includes information on plant distribution, mode of use, active principles, part of the plant used, toxicology in man and occasional notes on use of these plants in folk-medicine. Most of the active principles are saponins, alkaloids, glycosides, essential oils or cyanogenetic substances. --G. A. Emerson.

8472. Roberts, John L. (Dept. Zool., Univ. Massachusetts, Amherst). 1964. METABOLIC RESPONSES OF FRESH-WATER SUNFISH TO SEASONAL PHOTOPERIODS AND TEMPERATURES. In: First International Symposium on Problems of Quantitative Biology of Metabolism, Helgoland, 24-26 Sept., 1963. Helgolander Wissenschaftliche Meeresuntersuch 9(1/4): 459-473. Illus. (German summ.); Biological Abstracts, 46(18): Abst. No. 78925. 1965.

Metabolic compensations by pumpkinseed sunfish, Lepomis gibbosus, to photoperiods of 9 and 15 hours and to acclimation temperatures ranging between 5° and 25° C have been examined. Respiration rates of whole fish, their brain,

gill and muscle tissues, and opercular frequencies were used as indices of adaptation. Techniques for the determination of respiration rates and opercular frequencies were outlined and discussed. A range in thermal homeostasis has been found for L. gibbosus over which thermal acclimation of respiration is nearly perfect (Q_{10} about 1), but which is modifiable by alterations in day length above 10° C. Although less obvious, a relative thermal homeostasis was detected for opercular frequency as well. Perfection of acclimation appears to be best with both indices in the groups of sunfish which have been adapted to the 15-hour photoperiod. Significant differences in rates of respiration, but not in opercular frequencies, have been observed between the long and short-day groups of fall and winter sunfish above 10° C. During spring and with sunfish in breeding condition, these differences were not detected. Both short and long-day fish showed the same higher level of respiration found to be related to short photoperiod adaptation (9 hours). It is suggested that the photoperiodic effect of inducing changes in metabolic rates, most directly relates to some process of conditioning the fish for their primary biological function, reproduction. Because the characteristics and photoperiod sensitivity of metabolic compensations for temperature by L. gibbosus are not apparent below 10° C, this temperature is considered to be critical ecologically for the species in western Massachusetts. The existence of a lower critical temperature for thermal homeostasis of metabolic functions (capacity adaptation) in sunfish is stressed because of its potential as a sensitive indicator of physiological variations for climate and latitude. No indications of compensation for photoperiod (9 and 15 hrs.) and temperatures (7.5° and 20° C) have been detected in the respiration of brain and gill tissues of L. gibbosus at 25° C except after uncoupling with dinitrophenol. The response of brain respiration with the drug appears to be greatest in sunfish adapted to a 9-hour day and 20° C. In contrast, the dinitrophenol effect upon respiratory change of gill filaments appears to be reversed with respect to the thermal history of the donor fish (highest with acclimation to 7.5° C), but unrelated to the length of the adaptation photoperiod. It is apparent that metabolic systems in different tissues of the same animal or the same tissues in different species, contrast greatly in compensatory responses to temperature and photoperiod. Therefore, the suggestion is offered that the resultant of systemic integration often may be more significantly reflected in responses of whole fishes to changing environmental factors than the possible direct effects of temperature sometimes seen in isolated tissues. (Auth.)

8473. Meyer, F.P., and J.D. Collar (Bur. Sport Fisheries and Wildlife, Fish Farming Experimental Sta., Stuttgart, Arkansas). 1964. DESCRIPTION AND TREATMENT OF A PSEUDOMONAS INFECTION IN WHITE CATFISH. Appl Microbiol 12(3): 201-203.

A virulent organism of the genus Pseudomonas was isolated from the white catfish, Ictalurus catus. The bacterium was pathogenic to all species of fish tested. Symptoms of the disease, physiological characteristics of the pathogen and treatment methods are presented. Kanamycin injected intraperitoneally or oxytetracycline used as a feed additive was effective in controlling the disease. The growth and biochemical characteristics do not fit any description in Bergey's Manual, but the organism appears to be closely related to P. fluorescens. (Authors)

8474. Mizelle, John D., and John W. Crane (Sacramento State College, Sacramento, Calif.). 1965. STUDIES ON MONOGENETIC TREMATODES, XXIII. GILL PARASITES OF Micropterus salmoides (Lacépède) FROM A CALIFORNIA POND. Trans. Amer. Microscop. Soc., 83(3): 343-348; Biological Abstracts, 46(18): Abst. No. 82302. 1965.

Branchial Monogenea of Micropterus salmoides survive conditions necessitated by transportation to new and relatively far removed areas. Few structural differences of such parasites on this host were evident when compared with corresponding spp. from other areas in the United States. California specimens are longer, and 3 of the 4 spp. also are maximally wider. This observation may not be entirely valid because of the smaller number of available measurements for comparison from other areas. A cuticularized structure that regularly occurs

between the tips of the ventral anchors of Actinocleidus fusiformis was observed for the first time. Similarly a seminal receptacle and a basal projection on the accessory piece of Clavunculus unguis were observed also. Though not structural, the occurrence of this sp. on the gill bars and gill rakers as well as on the gill filaments is unique for Monogenea on this host. A heretofore unrecorded baglike structure enclosing a smaller seminal receptacle in Urocleidus furcatus was observed in this investigation. In U. principalis the seminal receptacle was observed to occur as in the original description but a new variation expressed as an elongate receptacle with a sclerotized proximal portion was observed. Two refractile structures situated immediately in front of the anterior eyespots were observed consistently in this sp. for the first time. --John D. Mizelle.

8475. Abakumov, V. A. 1964. ON THE MARINE PERIOD OF LIFE OF THE PACIFIC LAMPREY (Entosphenus tridentatus (Richardson). Tr Vses Nauch Issled Inst Morsk Rybn Khoz Okeanogr 49: 253-256. From: Ref Zh Biol., 1964, No. 22I48. (Translation); Biological Abstracts, 46(19): Abst. No. 83045. 1965.

During the work on deck of a fishing trawler in the central Bering Sea in 1958, fish taken from depths of 300-500 m exhibited marks of lamprey suckers. A lamprey 660 mm long was obtained from a depth of 380 m, and a second specimen, measuring 578 mm in length, from a depth of 300-338 m. Sucker marks were also found on Greenland halibut and on American and Asiatic arrow-toothed halibuts, as well as on sable fish. The presence of lamprey sucker marks on these fishes, combined with the fact that lampreys were caught in deep water, suggests that the Pacific lamprey lives at great depths.

8476. Krykhtim, M. L. 1964. TAGGING OF AUTUMN CHUM SALMON Oncorhynchus keta inf. autumnalis Berg AND PINK SALMON Oncorhynchus gorbuscha (Walb.) IN THE AMUR ESTUARY. Vop Ikhtiol 4(2): 270-279; Biological Abstracts, 46(19): Abst. No. 83059. 1965.

Tagging studies of 3026 pink salmon and 200 autumn chum salmon conducted in the summers of 1956, 1957, and 1958, have shown that the main mass of the autumn chum spawning population ascended along the left bank of the Amur estuary with a speed of 25 km per day (24 hr). Pink salmon from Nevelskoye Strait ascended along the right bank of the estuary, and then across it to the left bank, at 13 km per day. The fish stayed 3 to 4 days in the estuary where they became adapted to freshwater. Autumn chum with sexual products in early stages of development moved more slowly upriver than those with sexual products in later stages of development. Chums from the Amgun River predominated in the estuarine catches. Nearly 60-65% of the Amur autumn chum population spawned in Amur tributaries situated above the Amgun River, while 35-40% spawned in the Amgun basin and tributaries of the estuary and of Lake Orel. --D. M. Cutler.

8477. Lapin, Yu. E. (Severtzov Inst. Anim. Morphol., Acad. Sci. USSR, Moscow). 1964. SOME CHARACTERISTICS OF THE POPULATION DYNAMICS OF PACIFIC PINK SALMON Oncorhynchus gorbuscha (Walbaum). Vopr Ikhtiol 4(2): 233-242. Illus.; Biological Abstracts, 46(19): Abst. No. 83060. 1965.

The author attempts to show that changes in the abundance of pink salmon are of an adaptive character. The concept of "self-regulation" of stock abundance by predation and competition for food, propounded by Ricker in 1962, cannot, in the author's opinion, be accepted because it places the individual in opposition to his environment. The present author holds that a population lives in unity with the environment (Vasmetsov's theory) and that a change in population abundance represents an adaptive response to environmental changes. Accordingly, changes in the abundance of pink salmon are associated with changes in the reproductive capacity of the stock resulting from changes in the food supply. --D. M. Cutler.

8478. Lavrovskii, V., and A. Uspenskaya. 1959. AN EFFECTIVE METHOD OF CONTROLLING DACTYLOGYRIASIS. Rybovodstvo i Rybolovstvo 6. 31-32; Referat. Zhur., Biol., 1960, No. 71608. (Translation); Biological Abstracts, 46(19): Abst. No. 83061. 1965.

Ammonia baths are effective against Dactylogyrus especially in carp infected with Dactylogyrus solidus. A 0.2% solution of NH_3 at a temperature of 10° and an exposure of 1 minute are recommended. The NH_3 solution should not be used for more than 10 minutes. During this period, 2-3 batches of fish are passed through. --Courtesy NSF (PL 83-480) 1963.

8479. Fahlen, G., B. Falck, and E. Rosengren (Dept. Histol., Univ. Lund, Lund, Sweden). 1965. MONOAMINES IN THE SWIMBLADDER OF Gadus callarias AND Salmo irideus. Acta Physiol Scand 64(1/2): 119-126. Illus.; Biological Abstracts, 46(19): Abst. No. 84458. 1965.

The noradrenaline in the swimbladder of the cod and the rainbow trout is stored in short adrenergic neurons whose perikarya are located in close relation to the swimbladder itself. In the cod, the noradrenergic neurons are innervated by noradrenergic neurons that arise from the coeliac ganglion of the sympathetic chain. A hitherto unknown system of epithelial cells storing 5-hydroxytryptamine was observed in the trout swimbladder. (Authors)

8480. Harms, Clarence E. (Tabor College, Hillsboro, Kansas). 1965. THE LIFE CYCLE AND LARVAL DEVELOPMENT OF Octospinifer maclientis (Acanthocephala: Neoechinorhynchidae). Jour. Parasitol., 51(2): 286-293. Illus.; Biological Abstracts, 46(19): Abst. No. 86842. 1965.

The acanthocephalan, Octospinifer macilentis, is an intestinal parasite of the common sucker, Catostomus commersoni. Ostracods, Cyclocypris serena, Physocypria pustulosa, and Cypridopsis sp., along with other arthropods, were fed infective ova. Only C. serena sustained infections until cystacanth larvae developed. Eggs hatched inside the intermediate host within 4 hr. and liberated spindle-shaped acanthors with anterior spines. Attempts to induce hatching artificially by proteolytic enzymes failed. Motile acanthors penetrated the gut within 24 hr. After 4 days in tissues dorsal to the gut, acanthors moved into the hemocoel and by the 5th day lost their spines and became immobile. Acanthella stages revealed changes in the entoblast: the anterior section gave rise to the brain, proboscis receptacle, and proboscis muscles; the posterior section formed the genital complex; between the two sections the pseudocoel appeared. The epidermis, formed from the peripheral cytoplasm, contained nine giant nuclei—six remained in the epidermis and three moved into the lemnisci after 25 days. The octamerous nature of the proboscis became apparent after 20 days when the hooks, in three rows of eight each, developed from the dermis. Differentiation of the genital apparatus distinguished the sexes by day 20 when two testes appeared within a single ligament sac and ovarian masses differentiated within two ligament sacs. By day 30 the proboscis of the cystancanth was capable of inversion and protrusion, epidermal nuclei were in their characteristic sites, and the gonads were distinct. No transport host was required to carry the cystancanth to a definitive host. In this respect, O. macilentis differs from Neoechinorhynchus cylindratus and N. emydis. Catostomus commersoni was successfully infected by force-feeding with parasitized ostracods. Moxostoma aureolum and Notropis dorsalis failed to acquire infections. In the definitive host, worms were established in the intestine within 4 hr. Maturity was reached after approximately 8-10 weeks for males and 16 weeks for females.

8481. Sytina, L. A. (Dept. Cytol., Moscow State Univ., Moscow, USSR). 1964. BIOLOGY OF THE IMMATURE AMUR GRAYLING (Thymallus arcticus grubei). Zool. Zh., 43(11): 1659-1668. Illus. (English summ.); Biological Abstracts, 46(19): Abst. No. 87067. 1965.

The Amur grayling fry can be divided into several groups by its size: 12-14 mm, 14-17 mm, 17-20 mm, 20-24 mm, 24-31 mm, 31 mm and larger. Within each of these groups a relation can be observed between the morphological structure (development of fins body shape, digestive tract) and behavior. With the advance of growth of the fry and an increase in its motility a gradual transition takes place from the dwelling in quiet parts of the river to that in sites with a more rapid flow and in the main channel. The spectrum of food undergoes

corresponding changes: the fry transits from feeding on less motile organisms to the consumption of larger and more motile ones met with in the guts of adult graylings. A peculiar feature of the grayling fry is their downstream migration of the river My to pre-firth territory of this river and to the firth of the Amur, which seems to be related to the presence of 2 shoals, land-locked and through-running ones. The young which migrate downstream do not differ from those remaining in the river either in their size or in morphological peculiarities. (Auth.)

8482. Kobayasi, Hiromu (Asahigawa College, Hokkaido, Japan). 1963. SOME CYTOLOGICAL OBSERVATIONS ON FERTILIZATION IN THE CROSS BETWEEN THE DOG-SALMON AND THE PINK-SALMON. Cytologia 28(4): 365-375. Illus.; Biological Abstracts, 46(20): Abst. No. 87237. 1965.

The process of fertilization and the course of early cleavages in the cross between the dog-salmon (Oncorhynchus keta) and the pink-salmon (Oncorhynchus gorbuscha), and in its reciprocal cross were found to proceed in normal manner. No di- and poly-spermic condition in insemination was found. The behavior of the chromosomes during early cleavage of the hybrid egg showed nothing unusual. There was no lag or elimination of any chromosomes. There was no evidence to indicate that the spermatozoa acted as a parthenogenetic agent. (Auth.)

8483. Brown, Bradford E. (Univ. Auburn, Auburn, Alabama). 1965. MERISTIC COUNTS OF STRIPED BASS FROM ALABAMA. Trans. American Fisheries Soc., 94(3): 278-279; Biological Abstracts, 46(20): Abst. No. 87505. 1965.

Nineteen Roccus saxatilis from the Alabama river system were examined for meristic character. These fish have access to the Gulf of Mexico. Lateral line scales were significantly greater than for Roccus saxatilis taken from the Atlantic Coast. (Auth.)

8484. Clark, John R., Michael Westerfield, and Herbert Austin (Bur. Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, New Jersey). 1964. MIGRATIONS OF THE ATLANTIC STRIPED BASS. Underwater Naturalist, 2(2): 5-6.

A study of the records from the Schaefer Fishing Contest for 1960, 1961, and 1962, corroborated by an analysis of over 500 returns from the Tag-A-Striper Contest, has yielded information on the seasonal whereabouts of large striped bass, Roccus saxatilis. In Long Island Sound, spawning follows an April burst of activity. Another buildup in late July may represent the reappearance of spawning fish joined by incoming southern fish. A third peak in late August and early September presumably represents the returning migrants from the north. --R. W. Topp.

8485. Marchetti, Roberto (Inst. Zool., Univ. Via Celoria, Milano, Italy). 1965. THE TOXICITY OF NONYL PHENOL ETHOXYLATE TO THE DEVELOPMENTAL STAGES OF THE RAINBOW TROUT, Salmo gairdnerii, Richardson. Ann Appl Biol 55(3): 425-430. Illus.; Biological Abstracts, 46(20): Abst. No. 87520. 1965.

Successive developmental stages of Salmo gairdnerii showed marked differences in their resistance to the action of the non-ionic surfactant, nonyl phenol ethoxylate. The alevins, immediately after hatching, were highly resistant and survived concentrations of up to 42 ppm for 6 hr. This resistance gradually decreased with the absorption of the yolk sac: when the yolk had been completely absorbed and before the fry had fed the lethal concentration was 2.5 ppm. After several days of feeding, resistance slightly increased but showed no further rise after 15 days. A concentration of 5.2 ppm of nonyl phenol ethoxylate for 6 hr was toxic both to 40- and to 210-day-old fish. It is considered that these changes in resistance are not correlated with changes in respiratory activity of the fish but with their water metabolism. (Auth.)

8486. Patton, D. K. (Northwestern Univ., Evanston, Illinois). 1964. MORE OBSERVATIONS FROM ARGUS ISLAND TOWER, BERMUDA, B. C. C. Underwater Naturalist, 2(2): 8-12. Illus.; Biological Abstracts, 46(20): Abst. No. 87531. 1965.

Barracuda up to 3-1/2 feet long were consistently grouped in tiers upcurrent

of the U. S. Navy Research Tower southeast of Bermuda. Most were observed between the surface and 60 feet, although a few were seen at the bottom in 192 feet of water. They usually remained placid during the daytime, but arose to a feeding frenzy in the early evening. Sharks were observed infrequently during the day, but their numbers apparently increased at night. A large school of jacks remaining in the center of the tower of varying depths above 90 feet were not disturbed by individual barracuda that swam through their midst. The rhythm of activity of all species was upset by a hurricane. Comparisons are made between the aggregation of fishes around the Argus Tower and that of the North Atlantic Texas Towers off Cape Cod. --R. W. Topp.

8487. Peters, John C., and William Alvord (Montana Fish and Game Dept., Helena). 1964. MAN-MADE CHANNEL ALTERATIONS IN THIRTEEN MONTANA STREAMS AND RIVERS. Trans. N. Amer. Wildlife Natural Resources Conf., 29: 93-102; Biological Abstracts, 46(20): Abst. No. 87533. 1965.

There were 1,987 individual alterations in the 768 miles of stream channel inventoried. As a result of the man-made alterations, the length of the channels was shortened by 68 miles. Agricultural activities accounted for the greatest length of channel altered followed in order by railroad construction, road construction, and urban and industrial development. Relocated channels accounted for the greatest length of channel altered followed in order by riprapping, diking, and channel clearance. Standing crops of game fish were several times more abundant in natural, meandering channels than in altered channels. (Authors)

8488. Reynolds, James B. (Iowa State Univ. Sci. and Technol., Ames, Iowa). 1965. LIFE HISTORY OF SMALLMOUTH BASS, Micropterus dolomieui Lacepede, IN THE DES MOINES RIVER, BOONE COUNTY, IOWA. Iowa State Jour. Sci., 39(4): 417-436. Illus.; Biological Abstracts, 46(20): Abst. No. 91651. 1965.

From 1956 through 1962, 324 smallmouth bass were captured primarily in a 6.5-mile section of the Des Moines River, an area of marginal habitat for this species. Most were taken with electrofishing gear. Clumps of rubble near the banks were preferred habitat for both adults and young. Summer movements of smallmouth bass apparently do not exceed 2 miles, but greater movement may occur during periods of high water. The estimates of 21 bass per mile in 1960 and 11 bass per mile in 1961 were not significantly different. Adult bass moved out of the river and spawned in Fluff Creek during mid-June, 1962. Water levels may be more important in initiating smallmouth spawning activities than temperature. Male and female bass apparently do not spawn until their 3rd growing season. Female bass had from 4,964 to 15,203 ova. Fish, mostly cyprinids, and crayfish were the most important food items by volume. Slopes of the length-weight relationship did not vary significantly from year-to-year, and weight increased as the 3.0086 power of the length. Annual growth increment averaged 4.7 inches in each of the first 2 years of life and decreased each year thereafter. Growth of Des Moines River smallmouth bass was above the average reported in other parts of the country. Each year from 1954 through 1961 produced at least some smallmouth bass. Correlation coefficients (r) between annual growth increments of I, II, and III year old bass and average water level (May-October) approached -1.0 as the age of the fish decreased, suggesting that younger fish respond (in growth) more sensitively to changes in water level than do older fish. (Auth.)

8489. Ladiges, Werner (Zool. Staatsinst. u. Zool. Mus., Hamburg, W. Germany). 1962. QUESTIONS OF THE BEHAVIOR OF FRESH WATER FISHES IN A LARGE AQUARIUM. In: 1st International Congress of Aquariology, Monaco, 1960. Bull. Inst. Oceanog. Monaco, Spec. No. 1A. pp. 97-108. Illus. (French and English summ.); Biological Abstracts, 46(21): Abst. No. 91717. 1965.

The choice of fishes suitable for freshwater aquaria depends on the type and aim of these establishments. With this purpose in view the following were described: the geographical aquarium; the ecological-biological aquarium; fishing exhibitions, or exhibitions by way of diversion; systematic collections; and examples of development, particularly biological-ecological development. The

requirements of freshwater fishes dealt with are stated in general and with particular reference to different set examples. The most important factors are the quality of the water and the composition of the food supply. Finally the various opinions concerning maintenance either separately, in shoals or within a community are discussed, as well as the difficulties in their upkeep resulting from the external behavior of the fishes. (Auth.)

8490. Allyn, Rube. 1965. A DICTIONARY OF FISHES. 9th ed. (Illustrations by Jim Weakley) 140 p. Great Outdoors Publishers: Saint Petersburg 14, Florida. Pr. $1.50.; Biological Abstracts, 46(21): Abst. No. 91721. 1965.

Members of the Great Outdoors Association contributed to this revised edition which contains over 300 new points of information. The common and scientific name, size, edibility, color, characteristics, habitat and food are given for 700 species of fish. The book is intended for fishermen but can be useful to students of marine biology and ichthyology. There is an index. --A. Anderson.

8491. Gaufin, Richard F., and Arden R. Gaufin (Univ. Utah, Salt Lake City). 1964. DIURNAL MOVEMENTS OF FISH IN FISH LAKE, UTAH. Proc. Utah Acad. Sci. Arts Letters 41(1): 58-60. Illus.; Biological Abstracts, 46(21): Abst. No. 92225. 1965.

Fish Lake, Utah, is a high mountain lake providing sport to a great number of people. Its peculiar shape and water character have allowed a situation to develop which does not fit the stereotyped pattern for a lake of this type. The lake is of great enough importance as a fishing area to warrant investigation of its management problems. The question of the importance of the Utah chub, Gila atraria, to the lake economy is a pressing one. An attempt to determine the actual significance of this fish has shown a strong tendency toward diurnal movements within the lake. If further studies indicate the need of a chub control program, this factor could considerably facilitate the treatment program. (Authors)

8492. Nose, Takeshi, and Hiroko Mamiya (Freshwater Fish. Res. Lab., Tokyo, Japan). 1963. PROTEIN DIGESTIBILITY OF FLATFISH MEAL IN RAINBOW TROUT. Bull. Freshwater Fish. Res. Lab., 12(2): 1-4. Illus. (In Japanese with English summ.); Biological Abstracts, 46(21): Abst. No. 92241. 1965.

The protein digestibility of several lots of flatfish meal, manufactured on factory ships in the Bering Sea was estimated by using fingerling of rainbow trout. The absorption of protein was determined by the indirect method in which chromium oxide was used as an indicator. Fairly high values were obtained, ranging from 79 to 95%. The protein digestibility was found to be in distinct positive correlation (r=0.984) with the protein content of fish meal and in a negative one (r=0.829) with ash content. Neither fat content nor storage period of fish meal seemed to exert any appreciable influence on the digestibility. In addition, ether extraction slightly improved the digestibility of some lots but the effect was not so marked. (Authors)

8493. Abrosov, V.N., and N.A. Zabegalina. 1963. THE HYDROCHEMICAL CHANGE IN LAKE OKUNEVETS UNDER THE ACTION OF LIMING AND FERTILIZING. Izv Gos Nauch Issled Inst Ozern Rechn Rybn Khoz 55: 38-46. (English summ.). From: Ref Zh Biol., 1964, No. 12D266. (Translation); Biological Abstracts, 46(22): Abst. No. 96966. 1965.

The lake is in Pskov Oblast and has an area of 6 ha, an average depth of 4.5 m and a maximum of 8, and a volume of 280,000 m^3. Before its conversion it had both oligotrophic and dystrophic characteristics. The water had a pH of 6.0 and water extracts of the ooze 6.5, the transparency of the water was 6 m, color index was VI on the Forel and Uhl scale, the littoral had no higher aquatic vegetation and only filamentous algae developed there on a large scale; the fish productivity was about 15 kg/ha. In 1959 work was begun to convert it into a eutrophic lake by liming and the application of mineral fertilizers. The 3-year experiment in converting the lake made it possible to accomplish a sharp increase in fish production (up to 87.8 kg/ha in 1962) which became higher than in better eutrophic lakes in Pskov Oblast. Lake Okunevets has not been completely converted in 3 years. Its

water is still insufficiently buffered, it has a variable pH, and in winter its water is acidic. Liming must be continued until an alkaline reaction is established at all depths of the lake.

8494. Holden, A. N. (Freshwater Fisheries Lab., Pitlochry, Perthshire, Scotland, U. K.). 1965. CONTAMINATION OF FRESH WATER BY PERSISTENT INSECTICIDES AND THEIR EFFECTS ON FISH. In: Proceedings of the Association of Applied Biologists, Symposium on the problem of persistent insecticides in British agriculture, London, 16 October, 1964. Ann. Appl. Biol., 55(2): 332-335; Biological Abstracts, 46(22): Abst. No. 96976. 1965.

Persistent insecticides can accumulate in fish, causing acute or chronic toxicity. Analyses of trout and salmon in Scottish waters have shown the presence of dieldrin, DDT, TDE, and DDE in organs and tissues. The highest concentrations, similar to those in trout killed in toxicity tests, were found in fish killed by dieldrin-BHC sheep dips. Examples are given of dieldrin levels in fish, invertebrates, algae and water after pollution particularly by sheep dips. Sub-lethal effects may exist in some fish, while predatory fish and birds may accumulate more dangerous quantities. (Auth.)

8495. Solomon, Gordon, Rue Jensen, and Howard Tanner (College of Veterinary Medicine, Colorado State Univ., Ft. Collins, Colo.). 1965. HEPATIC CHANGES IN RAINBOW TROUT (Salmo gairdneri) FED DIETS CONTAINING PEANUT, COTTONSEED, AND SOYBEAN MEALS. Amer. Jour. Veterinary Res., 26(112): 764-770. Illus.; Biological Abstracts, 46(22): Abst. No. 97515. 1965.

Shasta strain rainbow trout randomized into 3 treatment groups for testing the following diets: (1) control diet, (2) control diet plus toxic groundnut (peanut) meal at a concentration of 15 parts per billion, and (3) cottonseed meal which replaced the soybean meal in the control diet. Liver sections from fish in each group were examined microscopically at 6-, 9-, and 12-month intervals. Marked and varied hepatic alterations including hyperplasia of bile duct epithelium, marked cholangitis, hepatoma, and cholangioma were caused by the toxic groundnut (peanut) meal diet. Hyperplasia of bile duct epithelium and cholangitis were observed in small and medium bile ducts in fish fed the cottonseed meal diet. Significant changes were not observed in fish fed the control diet. (Authors)

8496. Stokes, R. M., and P. O. Fromm (Dept. Physiol. and Pharmacol., Michigan State Univ., East Lansing, Mich.). 1965. EFFECT OF CHROMATE ON GLUCOSE TRANSPORT BY THE GUT OF RAINBOW TROUT (PISCES). Physiol. Zool. 38(3): 202-205; Biological Abstracts, 46(22): Abst. No. 97516. 1965.

Rainbow trout (Salmo gairdneri) were exposed to 2.5 mg Cr (available as chromate)/l for 7 days. The in vitro glucose transport of gut segments from these animals was compared to that by similar segments from untreated controls. The glucose transport of mid-gut segments from control fish was 18.4 $\pm$ 2.7 (SE) μg/mg dry wt/hr compared to 7.1 $\pm$ 1.5 (SE) for pyloric cecal segments. The transport by caecal and mid-gut segements from chromium exposed fish were 40 and 32% lower respectively than those of controls ($p=0.10$). It is suggested that this decrease is primarily the result of an inhibition of the entry of glucose into the epithelial cells caused by the presence of chromium in these tissues. (Authors)

8497. Shelton, William L. (Dept. Zool., Oklahoma State Univ., Stillwater, Okla.). 1963. OVARIAN MORPHOLOGY OF THE THREADFIN SHAD, Dorosoma petenense (Guenther). In: Fifty-first Annual Meeting of the Oklahoma Academy of Science, Tulsa, Oklahoma, 7-8 December, 1962. Proc. Oklahoma Acad. Sci., 43: 145-148. Illus.; Biological Abstracts, 46(22): Abst. No. 97990. 1965.

The ovary of the threadfin shad was found to have a wide range in sizes of developing eggs. Throughout the summer months females having enlarged ovaries were found; although unripe, it appeared possible for such ovaries to mature within a short period of time. The variety of developmental stages within a single ovary suggests the possibility of a single female spawning over an extended period of time. In the maturing follicles the follicular epithelium, chorion, vitelline membrane, and zona radiata were observed. Internal to the membranes granulosa, oil globules, nuclei and nucleoli were present. (Auth.)

8498. Oberg, K. E. (Inst. of Zoophysiol., Uppsala, Sweden). 1964. THE INHIBITION OF THE RESPIRATION OF BRAIN MITOCHONDRIA OF ROTENONE-POISONED FISH. Exp. Cell Res., 36(2): 707-710; Biological Abstracts, 46(23): Abst. No. 101169. 1965.

It is shown that glutamate-supported respiration of brain mitochondria from rotenone-treated fish, measured in rotenone-free medium, is significantly lower than that from control fish, whereas succinate-supported respiration is unchanged. The extent of the inhibition, 72%, indicates that rotenone has caused the difference in glutamate oxidation by acting on brain mitochondria in vivo. The results demonstrate that rotenone becomes so firmly bound to the mitochondria that it is not washed away during the preparation procedure. (Auth.)

8499. Ohno, S., C. Stenius, E. Faisst, and M. T. Zenzes (City Hope Med. Center, Duarte, California). 1965. POST-ZYGOTIC CHROMOSOMAL REARRANGEMENTS IN RAINBOW TROUT (Salmo irideus Gibbons). Cytogenetics, 4(2): 117-129. Illus.; Biological Abstracts, 46(23): Abst. No. 101228. 1965.

Four age groups of the rainbow trout (Salmo irideus) were surveyed in an extensive cytological study. While the basic diploid complement of this species was found to consist of 104 chromosome arms, some elements united and dissociated early in embryonic life; thus within each individual fish, from 2 to 7 distinct chromosome constitutions were identified, ranging from 2n=58 to 2n=65. Each somatic cell type tended to have a particular diploid chromosome number. Several multivalents were found in meiotic germ cells of both sexes. The Robertsonian type of chromosomal change which played an important part in the evolution of terrestrial vertebrates is seen within single individuals of this teleost fish. (Authors).

8500. Saito, Yutaka, Masamitsu Otsuru, Takeichi Furukawa, Kazuo Kanda, and Akiko Sato (Niigata Univ. Sch. Med., Niigata, Japan). 1964. STUDIES ON AN INFECTIOUS DISEASE OF RAINBOW TROUT. Acta Med Biol 11(3/4): 267-295, Illus.; Biological Abstracts, 46(23): Abst. No. 101561. 1965.

From bacteriological and histopathological views, the disease showing a high mortality rate was newly called "Furunculo-septicaemia" of rainbow trout by the present authors, the etiological agent being found identical with Vibrio piscium var. japonicus Hoshina, 1957. Detailed general descriptions of the etiological agent were given in this paper. The infection ports were experimentally found to be fish skin, gills, alimentary canal, particularly ocular area, injured skin and anal region. Chemotherapy by oral administration of sulfathiazole was effective. The dye malachite green was found to be practical for fish-pond water disinfection. The acquired immunity was demonstrated in the rainbow trout treated with vaccine injection for at least 3 months, during which period agglutinin, complement-fixing antibodies and relative increase of globulins were proved in the fish serum. (Authors)

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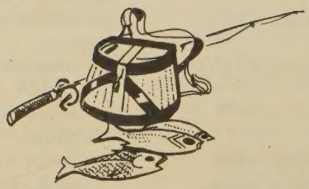

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